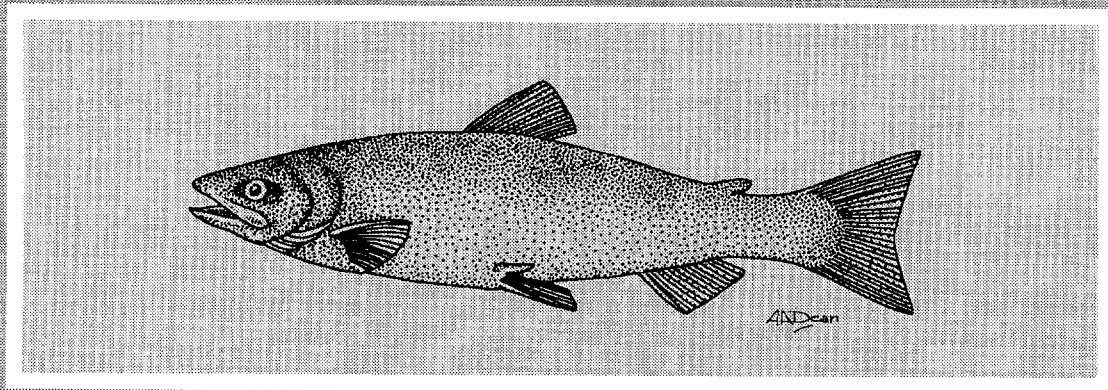


# **Stock Composition Studies of Situk River Sockeye Salmon, 1987 and 1988**



Regional Information Report No. 1J95-11

Alaska Department of Fish and Game  
Commercial Fisheries Management and Development Division  
Juneau, Alaska

March 1995

STOCK COMPOSITION STUDIES OF SITUK RIVER SOCKEYE SALMON,  
1987 AND 1988

By  
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and  
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Alaska Department of Fish and Game  
Division of Commercial Fisheries Management and Development  
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March 1995

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## ABSTRACT

Sockeye salmon smolts in the Situk River were tagged with coded wire tags in 1984. In 1987, returning adults were sampled from the Situk River commercial set gill net fishery, from the Yakutat Bay commercial set gill net fishery, and from the Situk River escapement. Situk River stock comprised an estimated 73% of the sockeye salmon harvested in the 1987 Situk River commercial set gill net fishery and 50% of the sockeye salmon harvested in the 1987 Yakutat Bay commercial set gill net fishery. The escapement of sockeye salmon into Mountain Lake totaled 17,172 fish in 1988 which represented 36% of the total Situk River escapement of 47,006 fish in that year. Mountain Lake sockeye salmon tended to pass the Situk River weir early and they comprised about 50% of the Situk River escapement from June 7 through July 3, 31% of the Situk River escapement from July 4 through July 21, and 28% of the Situk River escapement from July 22 through August 21. Differences in the age and average length at age of sockeye salmon spawning in various portions of the Yakutat Area and in the Situk River drainage provide the basis of a potential stock composition estimation tool for use by fishery researchers and managers.

KEY WORDS: Sockeye salmon; *Oncorhynchus nerka* catch and escapement; age, sex, and length; tagging; migratory timing; stock contribution; Situk River, Situk Lake, Mountain Lake, Southeast Alaska.

## INTRODUCTION

The Situk River near Yakutat, Alaska, supports a major commercial salmon set gill net fishery. Commercial harvests from the Situk River fishery averaged about 30,000 sockeye salmon annually during the five year period 1984-1988. Most of the sockeye salmon harvested in this fishery are believed to be returning to spawning locations in the Situk River drainage. The escapement of sockeye salmon past the commercial fishery and into the Situk River has been enumerated with the aid of a weir since 1975. Known sockeye salmon spawning locations in the Situk River system include tributaries and beaches of Situk and Mountain lakes, the stream connecting Situk and Mountain lakes, the Situk River below Situk Lake, the Old Situk River, the West Fork of the Situk River and Redfield Lake (Figure 1). Most of the spawning population is believed to return to the portion of the drainage located upstream of the outlet of Situk Lake.

During the 1980's, studies were initiated to research the stock dynamics of Yakutat Area salmon. Sockeye salmon from the Situk River escapement and in the commercial fishery were sampled to document age, sex, and size composition (McBride and Brogle 1983; McBride 1984; McBride 1986; Riffe et al. 1987; Pahlke and Riffe 1988; Pahlke 1989; Rowse 1990).

Specific studies of Situk sockeye salmon were also initiated in the 1980's. In 1984, sockeye salmon smolt outmigrating from the Situk River were tagged with coded wire tags. In 1987, the Situk River set gill net fishery and the Yakutat Bay set gill net fishery were sampled to recover returning three-ocean-age adult coded wire tagged sockeye salmon. In 1988, a weir was installed near the outlet of Mountain Lake and the sockeye salmon escapement into Mountain Lake was enumerated. Also in 1988, sockeye salmon passing the Situk River weir were captured and tagged with spaghetti tags. Although these coded wire tag and spaghetti tag studies of Situk River system sockeye salmon were summarized in various memoranda, results of this research have not been documented to date in a report. The purpose of this report is to summarize these research activities. Specific objectives included estimating the contribution of Situk stock sockeye salmon to the Situk River and Yakutat Bay commercial set gill net fisheries in 1987; estimating the temporal stock contribution of Mountain Lake sockeye salmon to the Situk River weir counts in 1988; and describing qualitative stock compositions of sockeye salmon in the Situk harvests and escapements based upon age and length data.

## METHODS

### **Abundance, Age, Sex, and Length Data**

Commercial catch data presented in this report were compiled by the Commercial Fisheries Management and Development Division of the Alaska Department of Fish and Game (ADF&G), and originated from fish tickets tabulated as of 3 April, 1989. A weir installed just upstream of the terminus of the Situk River provided daily and total counts of sockeye salmon returning to the Situk in 1988. A second weir installed at the outlet of Mountain Lake provided daily and total counts for that portion of the 1988 Situk sockeye salmon escapement.

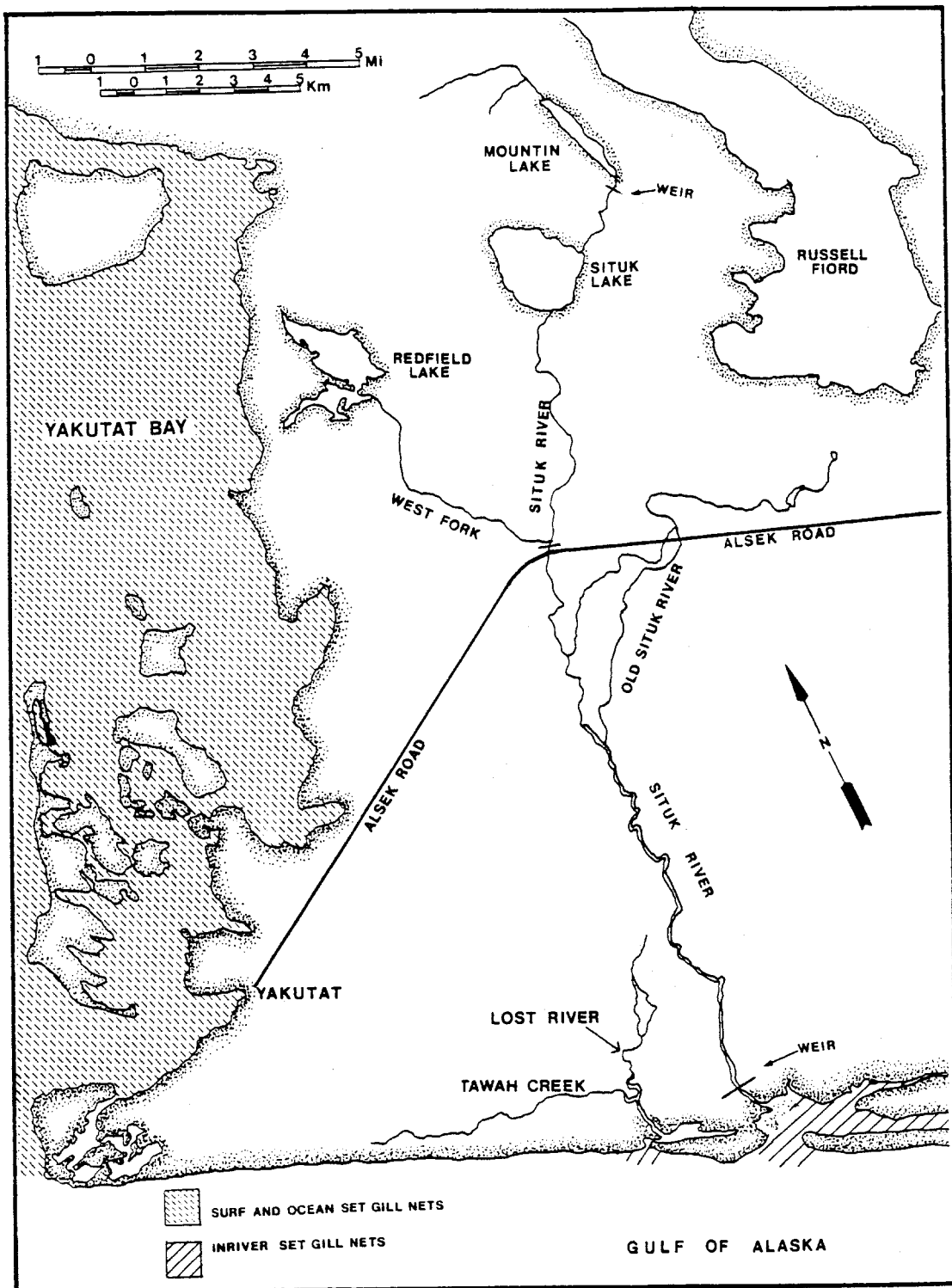


Figure 1. Map of Situk River system.

Sockeye salmon were sampled for scales, sex, and length from the Situk River catch and from the Situk River and Mountain Lake escapements. Scales were mounted on gummed cards and impressions made in cellulose acetate (Clutter and Whitesel 1956). Examination of scales provided age information for individual fish. Scales were magnified to 70X on a microfiche reader and ages were recorded in European notation (numerals preceding the decimal refer to the numbers of freshwater annuli, numerals following the decimal are the numbers of marine annuli, and the total age is the sum of these two numbers plus one). Ageing criteria followed that of Mosher (1968). Sex determination was based on examination of either gonads or external morphological features such as kipe development, belly shape, trunk depth, and jaw shape. Accuracy of sockeye salmon sex determination in a previous study conducted in Southeast Alaska in 1987 was 94% for 4,923 fish examined. Fish length was measured from the middle of the eye to the fork of the tail and was recorded to the nearest 5 mm.

### **Migratory Timing**

Sockeye salmon were tagged with colored and numbered spaghetti tags at the Situk River weir in 1988. Three different colors of tags were used over three time intervals. Orange tags were attached to fish passing through the weir from 17 to 29 June, yellow tags from 8 to 17 July, and blue tags from 26 to 29 July. Project staff waited 8 days after finishing one tag color before beginning to use the next tag color. Fish passing through the Mountain Lake weir were screened for presence or absence of tags. The observed number of sockeye salmon with tags of each color was recorded daily.

Migratory timing statistics were calculated for daily sockeye salmon counts at each weir, for daily numbers of fish with each tag color attached at the Situk River weir, and for daily numbers of each tag group observed at the Mountain Lake weir. Daily counts were used to calculate daily proportions of total abundance, cumulative abundance, and cumulative proportions. The empirical migratory time density function as described by Mundy (1979) was used to calculate mean timing date and variance. These mean timing dates were used to calculate travel time of sockeye salmon between the Situk River weir and the Mountain Lake weir.

### **Spaghetti Tag Analysis**

The proportions of the overall Mountain Lake sockeye salmon escapement passing through the Situk River weir in 1988 during the early, middle and late portions of the run were estimated from spaghetti tag information. Only a portion of the sockeye salmon at the Situk River weir were tagged and the tagging ratios were different for each of the three time periods (tag groups). A total escapement to marked ratio was calculated for each of the three tag groups. Total escapement was the sum of daily escapements from 7 June to 3 July for the orange group, 4 to 21 July for the yellow group, and 22 July to 21 August for the blue group. These escapement to marked ratios were multiplied by the number of tags observed at Mountain Lake weir to estimate

the proportion of the Mountain Lake sockeye salmon escapement which passed through the Situk River weir in 1988 during each of the three sampling periods.

The contribution of Mountain Lake fish to the overall run of sockeye salmon passing through Situk River weir during each of the three sampling periods was also estimated. This was done by multiplying the total Mountain Lake escapement by the proportion of the Mountain Lake sockeye salmon escapement which passed through the Situk River weir in 1988 during each of the three sampling periods. These resultant numbers for the early, middle and late time periods were then divided by the Situk weir escapement numbers for each of these time periods in order to estimate the contribution of Mountain Lake fish to the overall run of sockeye salmon passing through the Situk River weir during each of the three sampling periods.

### Coded Wire Tag Analysis

In 1987 catches of sockeye salmon were sampled for presence of coded wire tags to estimate contributions of Situk River fish to the Yakutat Bay and Situk River fisheries. Previously, these data had been analyzed and presented in a memorandum from Marianna Alexandersdottir to Don Ingledue, dated December 29, 1987. The 12/29/87 memorandum is presented in Appendix A. We reanalyzed the data to include only three-ocean-age sockeye salmon as detailed below.

Outmigrating sockeye salmon smolt in 1984 were tagged with coded wire tags and adipose-fin clipped. Sockeye salmon smolt were captured near the mouth of the Situk River with small mesh beach seines (Kissner 1985). These fish returned as three-ocean-age fish (ages 0.3, 1.3, and 2.3) in 1987 and provided the recoveries of fish with missing adipose fins. Samplers screened fish landed from the Yakutat Bay and Situk River set gill net fisheries in the summer of 1987 to determine marked to unmarked ratios. Fish were also screened at the Situk River weir to determine the proportion of fish in the escapement that were marked from the tagging program in 1984. Catch contributions in a stratum were estimated by (Clark et al. 1985):

$$C = \frac{Nm_c}{n_2r} \quad (1) ;$$

where: C = estimated contribution of Situk River fish;

N = total catch of age-.3 sockeye salmon;

$n_2$  = three-ocean-age sockeye salmon sampled;

$m_c$  = number of fish with missing adipose fins; and,

r = proportion of fish tagged in the 1984 outmigration.

The catch of age-.3 fish was obtained from the 1987 annual catch and escapement report for the Yakutat Area (Pahlke 1989). This total was the sum

of the catch of ages 0.3, 1.3, 2.3, and 3.3 in each fishery strata. The proportion of fish tagged in the 1984 outmigration (r) was estimated by dividing the total number of fish with missing adipose fins observed at the Situk River weir by the total that were screened for missing adipose fins and then multiplying that result by the number of age-.3 fish in the Situk River escapement.

## RESULTS

### Abundance, Age, Sex, and Length

A total of 52,108 sockeye salmon was harvested in the Situk River commercial set gill net fishery in 1988, approximately 75% more than the five year average harvest from 1984 to 1988 (Table 1). Approximately 75% (38,923 fish) of the harvest occurred in the three weeks from 26 June to 16 July (statistical weeks 27-29). The total sockeye salmon escapement through the Situk River weir in 1988 was 47,006 fish and the mean timing date (MTD) was 13 July (SD = 12.6 days; Table 2). The total sockeye salmon escapement into Mountain Lake in 1988 was 17,172 fish and the MTD was 27 July (SD = 16.7 days; Table 3).

Detailed tables of the sockeye salmon age and length compositions through time and tests for changes in age and length composition through time for the 1988 Situk River set gill net catch, Situk River escapement and Mountain Lake escapement are presented in Appendix B. No consistent trends were seen in the age composition of the Situk River sockeye salmon catch (Appendix Tables B-1 and B-2). In both the Situk River escapement and the Mountain Lake escapement age-2.2 fish decreased in relative abundance and age-2.3 fish increased in relative abundance (Appendix Tables B-5, B-6, B-9, and B-10). Fish from catches and escapements increased in average length as the season progressed (Appendix Tables B-3, B-4, B-7, B-8, B-11, and B-12).

Summaries of the age compositions of sockeye salmon for the three data sets indicate that both the Situk River catch and escapement were comprised of a very diverse age composition (Table 4). The Situk River escapement was comprised of four principle age classes: age 2.3 (25.1%), age 2.2 (23.8%), age 1.2 (20.2%), and age 1.3 (19.3%). The Situk River catch was comprised of five major age classes: age 1.3 (30.7%), age 2.3 (22.3%), age 1.2 (14.5%), age 0.3 (14.4%), and age 2.2 (12.4%). The Mountain Lake escapement was less diverse and was dominated by age 2.2 fish (49.1%), age 2.3 fish (33.0%), and age 3.2 fish (11.2%). The age compositions were significantly different between the three groups among all major age classes (Table 5).

Summaries of the average length of sockeye salmon by age class for the three data sets are presented in Table 6. Significant differences were found among the three principle age classes between the Mountain Lake escapement (ages 2.2, 2.3, and 3.2) and the Situk River escapement; Mountain Lake fish were smaller (Table 7). More significant differences were evident between the Situk River catch and both escapements; sockeye salmon caught were larger than escaped across all age classes.

Table 1. Catch of sockeye salmon in the Situk River (District 182-70) by week, during the five year period 1984-1988.

Statistical						
Week	1984	1985	1986	1987	1988	Average
24	0	0	0	0	0	0
25	1,982	1,273	0	0	0	651
26	2,496	2,067	0	1,417	2,802	1,756
27	1,599	0	0	6,324	11,272	3,839
28	0	4,585	1,045	14,576	12,057	6,453
29	0	4,206	4,554	8,816	15,594	6,634
30	0	2,765	1,512	20,069	5,932	6,056
31	0	1,567	0	7,485	1,276	2,066
32	825	1,342	0	2,621	1,605	1,279
33	398	342	0	1,130	838	542
34	79	239	331	425	530	321
35	17	108	124	289	102	128
36	4	121	44	67	31	53
37	1	1	4	50	28	17
38	0	3	3	128	35	34
39	0	1	0	2	5	2
40	0	0	0	0	1	0
41	0	0	0	0	0	0
Total	7,401	18,620	7,617	63,399	52,108	29,829

Table 2. Daily sockeye salmon counts and associated statistics from the Situk River weir, 1988.

Date	Daily Count	Cumulative Count	Daily Proportion of Total	Cumulative Proportion of Total
June 7	2	2	0.0000	0.0000
June 8	0	2	0.0000	0.0000
June 9	0	2	0.0000	0.0000
June 10	1	3	0.0000	0.0001
June 11	1	4	0.0000	0.0001
June 12	0	4	0.0000	0.0001
June 13	0	4	0.0000	0.0001
June 14	0	4	0.0000	0.0001
June 15	0	4	0.0000	0.0001
June 16	0	4	0.0000	0.0001
June 17	8	12	0.0002	0.0003
June 18	2	14	0.0000	0.0003
June 19	3	17	0.0001	0.0004
June 20	2	19	0.0000	0.0004
June 21	0	19	0.0000	0.0004
June 22	957	976	0.0204	0.0208
June 23	0	976	0.0000	0.0208
June 24	14	990	0.0003	0.0211
June 25	5	995	0.0001	0.0212
June 26	35	1,030	0.0007	0.0219
June 27	25	1,055	0.0005	0.0224
June 28	1,144	2,199	0.0243	0.0468
June 29	8,145	10,344	0.1733	0.2201
June 30	1,775	12,119	0.0378	0.2578
July 1	604	12,723	0.0128	0.2707
July 2	2,755	15,478	0.0586	0.3293
July 3	987	16,465	0.0210	0.3503
July 4	94	16,559	0.0020	0.3523
July 5	253	16,812	0.0054	0.3577
July 6	490	17,302	0.0104	0.3681
July 7	3,679	20,981	0.0783	0.4463
July 8	281	21,262	0.0060	0.4523
July 9	20	21,282	0.0004	0.4528
July 10	1,329	22,611	0.0283	0.4810
July 11	1,683	24,294	0.0358	0.5168
July 12	1,021	25,315	0.0217	0.5385
July 13	4,210	29,525	0.0896	0.6281
July 14	255	29,780	0.0054	0.6335
July 15	72	29,852	0.0015	0.6351
July 16	175	30,027	0.0037	0.6388
July 17	190	30,217	0.0040	0.6428
July 18	519	30,736	0.0110	0.6539
July 19	1,714	32,450	0.0365	0.6903
July 20	717	33,167	0.0153	0.7056
July 21	64	33,231	0.0014	0.7070

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Table 2. Continued, page 2 of 2.

Date	Daily Count	Cumulative Count	Daily Proportion of Total	Cumulative Proportion of Total
July 22	0	33,231	0.0000	0.7070
July 23	2,275	35,506	0.0484	0.7554
July 24	4	35,510	0.0001	0.7554
July 25	3,378	38,888	0.0719	0.8273
July 26	484	39,372	0.0103	0.8376
July 27	219	39,591	0.0047	0.8423
July 28	1,113	40,704	0.0237	0.8659
July 29	948	41,652	0.0202	0.8861
July 30	1,074	42,726	0.0228	0.9089
July 31	377	43,103	0.0080	0.9170
August 1	101	43,204	0.0021	0.9191
August 2	1,319	44,523	0.0281	0.9472
August 3	57	44,580	0.0012	0.9484
August 4	445	45,025	0.0095	0.9579
August 5	620	45,645	0.0132	0.9710
August 6	323	45,968	0.0069	0.9779
August 7	7	45,975	0.0001	0.9781
August 8	76	46,051	0.0016	0.9797
August 9	315	46,366	0.0067	0.9864
August 10	44	46,410	0.0009	0.9873
August 11	64	46,474	0.0014	0.9887
August 12	81	46,555	0.0017	0.9904
August 13	56	46,611	0.0012	0.9916
August 14	123	46,734	0.0026	0.9942
August 15	98	46,832	0.0021	0.9963
August 16	50	46,882	0.0011	0.9974
August 17	38	46,920	0.0008	0.9982
August 18	30	46,950	0.0006	0.9988
August 19	19	46,969	0.0004	0.9992
August 20	28	46,997	0.0006	0.9998
August 21	9	47,006	0.0002	1.0000
Mean Date of Migration = July 13			Variance = 159.3 Days	

Table 3. Daily sockeye salmon counts and associated statistics from the Mountain Lake weir, 1988.

Date	Daily Count	Cumulative Count	Daily Proportion of Total	Cumulative Proportion of Total
July 2	0	0	0.0000	0.0000
July 3	0	0	0.0000	0.0000
July 4	0	0	0.0000	0.0000
July 5	43	43	0.0025	0.0025
July 6	3	46	0.0002	0.0027
July 7	1,024	1,070	0.0596	0.0623
July 8	551	1,621	0.0321	0.0944
July 9	598	2,219	0.0348	0.1292
July 10	430	2,649	0.0250	0.1543
July 11	310	2,959	0.0181	0.1723
July 12	378	3,337	0.0220	0.1943
July 13	937	4,274	0.0546	0.2489
July 14	807	5,081	0.0470	0.2959
July 15	687	5,768	0.0400	0.3359
July 16	700	6,468	0.0408	0.3767
July 17	796	7,264	0.0464	0.4230
July 18	189	7,453	0.0110	0.4340
July 19	316	7,769	0.0184	0.4524
July 20	230	7,999	0.0134	0.4658
July 21	351	8,350	0.0204	0.4863
July 22	182	8,532	0.0106	0.4969
July 23	381	8,913	0.0222	0.5190
July 24	168	9,081	0.0098	0.5288
July 25	555	9,636	0.0323	0.5611
July 26	428	10,064	0.0249	0.5861
July 27	108	10,172	0.0063	0.5924
July 28	7	10,179	0.0004	0.5928
July 29	180	10,359	0.0105	0.6032
July 30	145	10,504	0.0084	0.6117
July 31	62	10,566	0.0036	0.6153
August 1	141	10,707	0.0082	0.6235
August 2	171	10,878	0.0100	0.6335
August 3	558	11,436	0.0325	0.6660
August 4	158	11,594	0.0092	0.6752
August 5	99	11,693	0.0058	0.6809
August 6	78	11,771	0.0045	0.6855
August 7	149	11,920	0.0087	0.6942
August 8	414	12,334	0.0241	0.7183
August 9	1,239	13,573	0.0722	0.7904
August 10	233	13,806	0.0136	0.8040
August 11	124	13,930	0.0072	0.8112
August 12	172	14,102	0.0100	0.8212
August 13	73	14,175	0.0043	0.8255
August 14	84	14,259	0.0049	0.8304
August 15	50	14,309	0.0029	0.8333

- continued on next page -

Table 3. Continued, page 2 of 2.

Date	Daily Count	Cumulative Count	Daily Proportion of Total	Cumulative Proportion of Total
August 16	65	14,374	0.0038	0.8371
August 17	78	14,452	0.0045	0.8416
August 18	88	14,540	0.0051	0.8467
August 19	34	14,574	0.0020	0.8487
August 20	82	14,656	0.0048	0.8535
August 21	174	14,830	0.0101	0.8636
August 22	486	15,316	0.0283	0.8919
August 23	494	15,810	0.0288	0.9207
August 24	312	16,122	0.0182	0.9389
August 25	83	16,205	0.0048	0.9437
August 26	70	16,275	0.0041	0.9478
August 27	7	16,282	0.0004	0.9482
August 28	59	16,341	0.0034	0.9516
August 29	50	16,391	0.0029	0.9545
August 30	174	16,565	0.0101	0.9647
August 31	162	16,727	0.0094	0.9741
September 1	141	16,868	0.0082	0.9823
September 2	187	17,055	0.0109	0.9932
September 3	65	17,120	0.0038	0.9970
September 4	22	17,142	0.0013	0.9983
September 5	9	17,151	0.0005	0.9988
September 6	21	17,172	0.0012	1.0000
Mean Date of Migration = July 27			Variance = 278.7 Days	

Table 4. Age composition of sockeye salmon in the Situk River escapement, in the Mountain Lake escapement, and in the Situk River catch, 1988.

Category	Brood Year	Age Class	Sample Size	Percent	Standard Error	Apportioned Escapement
Situk R. Escapement	1985	0.2	13	1.6%	0.4	759
		1.1	1	0.1%	0.1	50
	1984	0.3	6	0.7%	0.3	346
		1.2	173	20.2%	1.4	9,509
		2.1	2	0.2%	0.2	100
	1983	0.4	0	0.0%	0.0	0
		1.3	166	19.3%	1.3	9,087
		2.2	201	23.8%	1.4	11,204
		3.1	0	0.0%	0.0	0
	1982	1.4	1	0.1%	0.1	50
		2.3	217	25.1%	1.5	11,779
		3.2	67	7.8%	0.9	3,659
	1981	2.4	2	0.3%	0.2	124
		3.3	6	0.7%	0.3	339
	Total	All	855	100.0%		47,006
Mountain L. Escapement	1985	0.2	0	0.0%	0.0	0
		1.1	0	0.0%	0.0	0
	1984	0.3	0	0.0%	0.0	0
		1.2	7	2.0%	0.8	346
		2.1	1	0.2%	0.2	28
	1983	0.4	0	0.0%	0.0	0
		1.3	10	3.0%	1.0	521
		2.2	170	49.1%	2.7	8,423
		3.1	1	0.2%	0.2	28
	1982	1.4	0	0.0%	0.0	0
		2.3	136	33.0%	2.5	5,660
		3.2	46	11.2%	1.7	1,928
	1981	2.4	2	0.4%	0.3	66
		3.3	4	1.0%	0.5	172
	Total	All	377	100.0%		17,172
Situk River Catch	1985	0.2	20	1.0%	0.3	521
		1.1	0	0.0%	0.0	0
	1984	0.3	211	14.4%	1.0	7,504
		1.2	232	14.5%	1.0	7,556
		2.1	1	<0.1%	<0.1	14
	1983	0.4	5	0.3%	0.2	156
		1.3	412	30.7%	1.4	15,983
		2.2	194	12.4%	1.0	6,461
		3.1	0	0.0%	0.0	0
	1982	1.4	8	0.7%	0.2	365
		2.3	307	22.3%	1.2	11,620
		3.2	49	3.5%	0.6	1,824
	1981	2.4	0	0.0%	0.0	0
		3.3	2	0.2%	0.1	104
	Total	All	1,441	100.0%		52,108

Table 5. Tests for significant differences in the age composition of sockeye salmon in the Situk River escapement, the Mountain Lake escapement, and the Situk River catch, 1988.

Brood Year	Age Class	Situk R. Esc. versus Mountain L. Escapement	Situk R. Esc. versus Situk R. Catch	Mountain L. Esc. versus Situk R. Catch
1985	0.2	S*		S*
	1.1			
1984	0.3		S**	S**
	1.2	S**	S*	S**
	2.1			
1983	0.4			
	1.3	S**	S**	S**
	2.2	S**	S**	S**
	3.1			
1982	1.4			
	2.3	S**	S*	S**
	3.2	S*	S**	S**
1981	2.4			S
	3.3		S	S*

S = significant at probability = 0.10.

S\* = significant at probability = 0.05.

S\*\* = significant at probability = 0.01.

Table 6. Length composition (mm) of sockeye salmon in the Situk River escapement, in the Mountain Lake escapement, and in the Situk River catch, 1988.

Category	Brood Year	Age Class	Males			Females			Combined		
			Avg Length	Std Err	Samp Size	Avg Length	Std Err	Samp Size	Avg Length	Std Err	Samp Size
Situk R. Esc.	1985	0.2	438	14.3	9	513	16.0	4	461	14.6	13
		1.1	310	-	1	-	-	0	310	-	1
	1984	0.3	525	29.9	4	495	65.0	2	515	26.0	6
		1.2	492	5.8	93	472	5.6	68	486	4.0	173
		2.1	375	15.0	2	-	-	0	375	15.0	2
	1983	0.4	-	-	0	-	-	0	-	-	0
		1.3	565	4.9	91	546	5.4	63	558	3.5	166
		2.2	489	4.3	105	486	4.4	75	490	2.9	198
		3.1	-	-	0	-	-	0	-	-	0
	1982	1.4	630	-	1	-	-	0	630	-	1
		2.3	572	3.9	132	550	3.3	75	563	2.8	217
		3.2	505	7.6	35	501	5.0	28	503	4.5	67
	1981	2.4	555	25.0	2	-	-	0	555	25.0	2
		3.3	568	18.0	4	540	-	1	562	12.2	6
	Totals		528	2.9	479	512	2.8	316	521	2.1	795
Mountain Lake	1985	0.2	-	-	0	-	-	0	-	-	0
		1.1	-	-	0	-	-	0	-	-	0
	1984	0.3	-	-	0	-	-	0	-	-	0
		1.2	473	7.8	4	473	18.6	3	473	8.2	7
		2.1	-	-	0	390	-	1	390	-	1
	1983	0.4	-	-	0	-	-	0	-	-	0
		1.3	582	12.9	7	533	34.4	3	568	14.6	10
		2.2	482	3.5	82	484	2.9	88	483	2.3	170
		3.1	350	-	1	-	-	0	350	-	0
	1982	1.4	-	-	0	-	-	0	-	-	0
		2.3	574	3.5	65	540	4.1	71	556	3.1	136
		3.2	491	7.2	16	495	3.6	29	494	3.4	46
	1981	2.4	490	-	1	530	-	1	510	20.0	2
		3.3	535	5.0	2	530	-	2	533	2.5	4
	Totals		520	4.1	178	506	2.9	198	513	2.5	376
Situk R. Catch	1985	0.2	535	20.0	3	488	7.5	2	516	16.2	5
		1.1	-	-	0	-	-	0	-	-	0
	1984	0.3	584	7.0	23	566	3.8	37	573	3.7	60
		1.2	516	5.7	32	499	7.1	37	507	4.7	69
		2.1	-	-	0	-	-	0	-	-	0
	1983	0.4	-	-	0	600	-	1	600	-	1
		1.3	579	4.8	55	559	3.2	61	569	3.0	116
		2.2	520	4.7	35	499	6.3	21	512	4.0	56
		3.1	-	-	0	-	-	0	-	-	0
	1982	1.4	625	10.0	2	585	-	1	612	14.5	3
		2.3	574	4.0	43	563	3.6	41	569	2.7	84
		3.2	525	14.3	8	471	13.7	3	510	13.1	11
	1981	2.4	-	-	0	0	-	0	-	-	0
		3.3	590	-	1	0	-	0	590	-	1
	Totals		556	3.0	202	542	2.9	204	549	2.1	406

Table 7. Tests for significant differences in the length composition of sockeye salmon in the Situk River escapement, the Mountain Lake escapement, and the Situk River catch, 1988.

Brood Year	Age Class	Situk R. Esc. versus Mountain L. Escapement	Situk R. Esc. versus Situk R. Catch	Mountain L. Esc. versus Situk R. Catch
1985	0.2		S*	
	1.1			
1984	0.3		S*	
	1.2		S**	S**
	2.1			
1983	0.4			
	1.3		S*	
	2.2	S	S**	S**
	3.1			
1982	1.4			
	2.3	S		S**
	3.2			
1981	2.4			
	3.3	S*		

S = significant at probability = 0.10.  
S\* = significant at probability = 0.05.  
S\*\* = significant at probability = 0.01.

### Migratory Timing and Spaghetti Tagging Data in 1988

A total of 1,053 orange spaghetti tags were inserted into individual sockeye salmon during the early period (June 7 through July 3; Table 8). Sockeye salmon escapement past the Situk River weir during the early period was 16,465 fish and the escapement to marked ratio was 15.6:1. A total of 1,642 yellow tags were inserted into sockeye salmon during the middle period (July 4 through July 21). The escapement of sockeye salmon during the middle period was 16,766 fish and the escapement to marked ratio was 10.2:1. During the late period, July 22nd to August 21st, 1,850 sockeye salmon were tagged with blue tags. Escapement of sockeye salmon during the late period was 13,775 fish and the escapement to marked ratio was 7.4:1.

The early period, when orange tags were inserted, comprised 47.6% of the Mountain Lake sockeye salmon escapement or 8,181 fish (Table 9). The middle period (yellow tagging period) comprised 29.9% (5,137 fish) of the Mountain Lake escapement; and, the late period (blue tagging period) comprised 22.4% (3,855 fish) of the Mountain Lake escapement. These expansions indicated that Mountain Lake fish comprised 49.7% of the first period escapement at the Situk River weir, 30.6% of the second, and 28.0% of the third period. Mountain Lake fish comprised a decreasing proportion of the total Situk River sockeye salmon escapement as the season progressed.

The mean timing dates (MTD's) for sockeye salmon at both weirs, for the three tag colors inserted into sockeye salmon at the Situk River weir, and for tagged sockeye salmon with the three tag colors as they were observed at Mountain Lake weir are provided in Table 10. Number of sockeye salmon tagged daily at the Situk River weir and later observed (recovered) at the Mountain Lake weir are provided in Appendix Tables C-1, C-2, C-3, C-4, C-5, and C-6. The MTD at the Situk River weir was 14 days earlier than at the Mountain Lake weir (July 13th vs. July 27th). The MTD's for the three tagged groups of sockeye salmon indicate that fish tagged with orange tags took an average of 14 days, fish tagged with yellow tags took an average of 15 days, and fish tagged with blue tags took an average of 22 days to migrate from the Situk River weir to the Mountain Lake weir. These data are abnormal as travel time usually decreases as the season progresses.

Two factors likely affected the MTD's: (1) tag induced delays; and, (2) location of the Situk River weir. Tag induced delay is usually approximately 2 days (Ben Van Alen, ADF&G, Division of Commercial Fisheries Management and Development, Douglas, Alaska, personal communication). Hence, actual travel time for untagged fish is estimated at 12 days, 13 days, and 20 days for the three time periods. It is believed that the Situk River weir location caused fish to hold below the weir through mid-July. Fish were reluctant to migrate through the weir (June 7th to July 15th) because the weir was placed in clear shallow water over 100 m above deep holding pools. We estimate the weir-induced delay to be 14 days, which would apply to the first two tagging periods. Without the weir in place, travel time for the first two periods would likely have been approximately 26 days and 27 days and the fish may have held in Situk Lake maturing rather than holding in the river below the weir.



Table 8. Number of sockeye salmon tagged at the Situk River weir in 1988, escapement abundance, and unmarked to marked ratios.

Period and Tag Color	Situk Escapement Dates	Situk Escapement	Situk Tagging Dates	Number of Tags	Escapement to Marked Ratios	Marked to Escapement Ratios
1 Orange	6/07 to 7/03	16,465	7/17 to 6/29	1,053	15.6363	0.0640
2 Yellow	7/04 to 7/21	16,766	7/08 to 7/17	1,642	10.2107	0.0979
3 Blue	7/22 to 8/21	13,775	7/26 to 7/29	1,850	7.4459	0.1343
Totals		47,006		4,545		

Table 9. Tagging ratio probabilities expanded by tag group to Mountain Lake tag recoveries to estimate proportions of sockeye salmon at Situk River weir by period that were Mountain Lake fish.

Period	Situk Escapement	No. of Tags Recovered at Situk Mountain Lake	Tag Color	Marked Ratio (E/M) at Situk Weir	Mountain Lake Tags Expanded by E/M	Prop. of Mountain Lake Esc	Mountain Lake Sockeye in Situk Escapement Number	Prop.
1	16,465	286	Orange	15.6363	4,472	0.476	8,181	0.497
2	16,766	275	Yellow	10.2107	2,808	0.299	5,137	0.306
3	13,775	283	Blue	7.4459	2,107	0.224	3,855	0.280
Totals	47,006	844			9,387	1.000	17,172	0.365

Note: Tag loss, non-detection of tags, mortality of tagged sockeye salmon, etc probably occurred; the expanded tags do not add to 17,172; the difference is 7,785 fish (17,172-9,387). The Mountain Lake weir counts were 36.5% of the Situk River weir counts but only 18.6% of the fish tagged at the Situk River weir were observed at the Mountain Lake weir. In applying the expanded tag proportions to the total Mountain Lake escapement, it is assumed that the data anomalies are constant across all three time periods.

Table 10. Timing of sockeye salmon at Situk River weir and at Mountain Lake weir, dates when sockeye salmon were tagged at Situk River weir, mean dates when these tagged fish were observed at Mountain Lake weir, and estimated travel time between the two weirs.

Data Set	Dates	Mean Date	Standard Deviation	Estimated Travel Time
Situk River weir	6/07-8/21	7/13	12.6	
Mountain Lake weir	7/02-9/06	7/27	17.0	
Situk Orange Tags	6/17-6/29	6/28	1.3	
Situk Yellow Tags	7/08-7/17	7/13	2.8	
Situk Blue Tags	7/26-7/29	7/28	1.1	
Mountain Lake Orange Tag Recoveries		7/12	7.0	14 days
Mountain Lake Yellow Tag Recoveries		7/28	10.0	15 days
Mountain Lake Blue Tag Recoveries		8/19	8.4	22 days

### 1987 Coded Wire Tag Data

The results of the 1987 coded wire tag (CWT) analysis are presented in Table 11. A total of 22,274 sockeye salmon were examined at the Situk River weir in 1987 and 388 (marked/unmarked ( $r$ ) = 0.018) were observed to have missing adipose fins. The number of three-ocean-age fish (age -.3) in those sampled was 21,637 fish (89%).

Sockeye salmon with coded wire tags were recovered in statistical weeks 27 through 32 in the Situk River fishery and contributions of age-.3 fish using an  $r$  = 0.018 ranged from 66% in week 27 to 134% in week 29. Since the contribution of Situk River fish could not be greater than 100%, the  $r$  = 0.018 estimated from the weir data was too low; some clipped fish may not have been detected.

The contribution of Situk River fish could have been a maximum of 100% in week 29-31. Additionally, only 1% of the age-.3 fish were age 0.3 fish of Situk River origin (measured from the Situk River escapement age composition in 1987, see Pahlke 1989). By removing the age-0.3 fish that were not of Situk River origin, the maximum Situk River contribution was 93.1%, 86.5%, and 94.3% in weeks 29, 30, and 31. We calculated  $r$  values which would provide those contribution percents and averaged them to provide a more realistic estimator. The adjusted  $r$  value was 0.0259 and was applied to all weeks. Since a total of 35,017 sockeye salmon smolts were clipped in 1984, the total estimated outmigrating smolt population was 1,352,000 ( $35,017/0.0259$ ).

The adjusted contributions of age-.3 fish in the 1987 Situk River fishery ranged from 0.0% in week 26 to 93.3% in week 29 (Table 11; Figure 2). Note that during week 26 the Situk fishery was open only on the Arhnklin River. The contribution of Situk River fish for the season to the Situk River fishery was 73.1% (Table 11).

Sockeye salmon with coded wire tags were recovered in statistical weeks 25 through 30 in the Yakutat Bay fishery (Table 11). Contributions of age-.3 Situk River fish to the 1987 Yakutat Bay fishery ranged from 10.9% in week 27 to 73.1% in week 30; contribution for the season, summed across the sampled strata, was approximately 50% (Table 11).

### Qualitative Stock Composition

The age composition of sockeye salmon in the Situk River fishery and escapement can be used to make qualitative judgements regarding stock composition. For example, age-0. fish comprised 15.4% of the 1988 Situk River fishery, but only 2.3% of the Situk River escapement (Appendices B-1 and B-5). Since the Situk River weir enumerated all sockeye salmon into the Situk River, the additional age-0. fish in the fishery are mostly Arhnklin River fish, but may also include fish bound for other nearby rivers such as the Lost, Akwe, Italio, and East Rivers. In 1986 and 1987 age-0. fish comprised 15.2% and 11.8% of the Situk fishery and 1.4% and 1.0% of the Situk River escapement, respectively, indicating that the trend is true in other years

Table 11. Contribution of three-ocean-age Situk River sockeye salmon to Situk River and Yakutat Bay fisheries.

Fishery	Statistical Week in 1987										
& Statistic	24	25	26	27	28	29	30	31	32	Total	
<u>Situk River Fishery</u>											
Tags Recovered				35	34	19	71	30	10	199	
Total Tags				42	43	27	85	36	13	246	
Sockeye Sampled			919	3,730	3,502	1,196	3,874	1,701	803	15,725	
Sockeye Harvested			1,521	6,248	14,697	8,877	20,102	7,532	4,524	63,501	
Age .3 Sampled			868	3,521	3,306	1,118	3,668	1,531	726	14,737	
Age .3 Harvested			1,436	5,898	13,874	8,296	19,031	6,781	4,090	59,406	
Contribution age .3			0	3,908	10,026	11,133	24,503	8,856	4,069	62,496	
Percent			0.0	66.6	72.3	134.2	128.8	130.6	99.5	105.2	
r=0.0180											
Adj. Cont. age .3			0	2,716	6,968	7,737	17,029	6,155	2,828	43,433	
Percent			0.0	46.1	50.2	93.3	89.5	90.8	69.1	73.1	
r=0.0259											
<u>Yakutat Bay Fishery</u>											
Tags Recovered		5	22	2	11	12	5			57	
Total Tags		6	22	2	12	16	7			65	
Sockeye Samp	0	1,211	1,652	734	740	1,118	394			5,849	
Sock Har	1,942	2,891	2,412	1,884	3,120	11,071	1,623			24,943	
Age .3 Samp	0	1,189	1,565	710	740	1,084	370			5,657	
Age .3 Har	1,919	2,838	2,285	1,822	3,120	10,734	1,522			24,240	
Cont. age .3		796	1,785	285	2,811	8,802	1,602			16,080	
Percent		28.0	78.1	15.7	90.1	82.0	105.2			72.0	
r=0.0180											
Adj. Cont. age .3	553	1,240		198	1,953	6,117	1,113			11,176	
Percent	19.5	54.3		10.9	62.6	57.0	73.1			50.1	
r=0.0259											

Note: Only the Arhnklin River section of the Situk River fishery was open during statistical week 26.

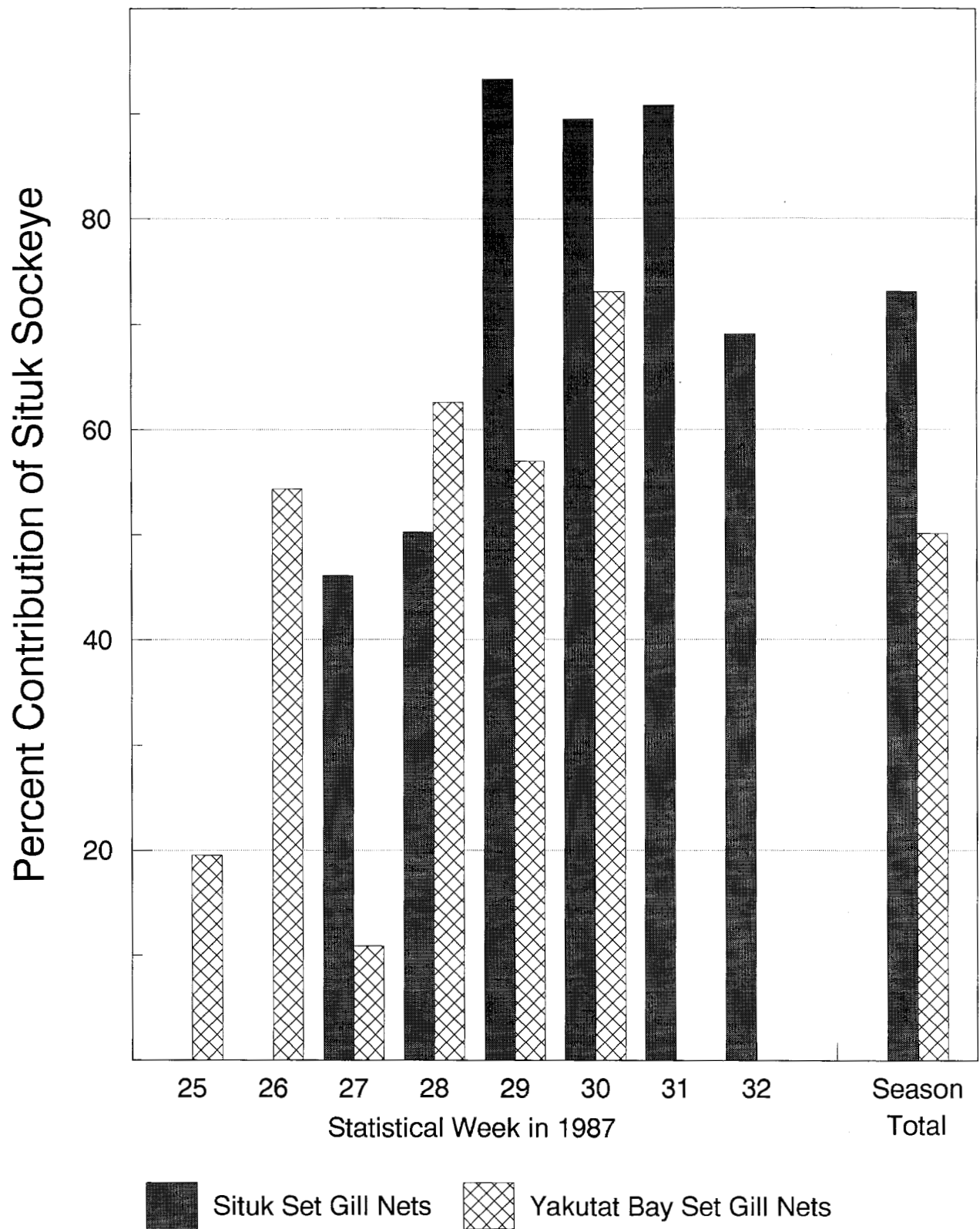


Figure 2. Contribution of Situk stock sockeye salmon to the set gill net fisheries in the Situk River and in Yakutat Bay, 1987.

(for 1986 data see Pahlke and Riffe 1988; for 1987 data see Pahlke 1989). However, because the Situk River escapement contains the only significant population of age-0 fish in the Yakutat Area, this age component may be the most useful in estimating relative stock proportions of sockeye salmon in Yakutat Bay and Manby Shore fisheries in some years.

The 1988 escapement of sockeye salmon in the Situk River was comprised of a greater percentage of age-1 fish than the Mountain Lake escapement (see Appendices B-5 and B-9). The 1988 escapement of sockeye salmon in the Situk River was comprised of 39.7% age-1 fish (ages 1.1, 1.2, 1.3, and 1.4). The 1988 Mountain Lake escapement of sockeye salmon, in contrast, was comprised of only 5.0% age-1 fish and was dominated by age-2 fish (82.5%). Most of the age-2 fish (75%) at the Situk River weir were Mountain Lake fish. Approximately 50% of ages 2.3, 3.2, 2.4, and 3.3 were Mountain Lake fish, but less than 6% of the Situk fish aged 1 and none of the fish aged 0 were from Mountain Lake.

The age composition of sockeye salmon in the Yakutat Bay fishery indicates a much larger age-0 component. The 1987 Yakutat Bay sockeye salmon catch was comprised of 45.3% age-0 fish (Table 12). All of the rivers along the outer Yakutat area coast produce age-0 sockeye salmon. Some sockeye runs, like that in the East Alsek River, are composed primarily of age-0 fish. The Situk River sockeye salmon run is composed of the lowest percentage of age-0 sockeye salmon of any of these rivers which include the Lost, Ahrnklin, Dangerous, Akwe, Italio, Alsek, East Alsek, and the Doame Rivers (Table 16). The Yakutat Bay sockeye salmon catches are composed of a higher percentage of age-0 fish early and late in the season and a lower percentage in mid-season, reflecting the increase in the contribution of Situk River fish. For example, in 1987 the Yakutat Bay catches were composed of 68.4% age-0 sockeye salmon in the first period (week 24), 39.6% during mid-season (week 28), and 52.2% during the last period (weeks 30-35). The high percentages of age-0 fish in the Yakutat Bay catches probably represent large contributions of sockeye salmon from the Ahrnklin, Italio, Akwe, and East Alsek rivers. Sockeye salmon catches in these rivers were composed of between 71.0% and 93.3% age-0 fish in 1987 (Table 12).

#### DISCUSSION

The quality of the management of a salmon stock relies on the quality of the information system available to the manager. Information on the size of the run and optimum spawning magnitude are essential. All sources of removal (harvests) should be accounted for and the escapement should be enumerated to accurately calculate run size. A run composed of more than one component stock can only reach maximum sustained production if the individual stocks are each achieving maximum production. Estimates of age structure for both catches and escapements provide a data base from which optimum escapement and production levels can be calculated.

Sockeye salmon catches and escapements have been enumerated accurately on a continuous basis since 1976 for the Situk River stock. The CWT analysis indicated that up to 50% of the Yakutat Bay catches were comprised of Situk

Table 12. Age composition of sockeye salmon from Yakutat Area commercial gill net fisheries, 1987.

Fishery	Percent Age Composition by Brood Year and Age											
	1985	1984		1983		1982		1981		1980		
	0.1	0.2	1.1	0.3	1.2	0.4	1.3	2.2	1.4	2.3	2.4	3.3
East Alsek	1.4	8.4	0.2	80.4	0.7	0.1	8.6	0.2	tr	0.1	0.0	0.0
Std. Err.	0.5	1.3	0.2	1.8	0.4	0.1	1.2	0.2	-	0.1	-	-
n = 1,369 and 1987 catch = 133,723												
Alsek	0.0	0.4	0.0	11.5	2.8	0.0	81.8	tr	0.5	3.1	0.0	0.0
Std. Err.	-	0.1	-	0.8	0.4	-	1.0	-	0.2	0.5	-	-
n = 1,653 and 1987 catch = 11,299												
Akwe	0.0	0.6	0.0	92.3	0.5	0.4	5.6	0.2	0.0	0.3	0.0	0.0
Std. Err.	-	0.5	-	1.3	0.3	0.3	1.2	0.2	-	0.2	-	-
n = 603 and 1987 catch = 12,133												
Italio	0.0	1.1	0.0	84.5	0.8	0.0	12.2	0.5	0.0	0.9	0.0	0.0
Std. Err.	-	0.6	-	1.8	0.3	-	1.6	0.3	-	0.6	-	-
n = 329 and 1987 catch = 778												
Ahrnklin	0.0	0.0	0.0	70.3	1.0	0.7	25.8	0.2	0.2	1.8	0.0	0.0
Std. Err.	-	-	-	1.7	0.3	0.3	1.7	0.1	0.2	0.5	-	-
n = 505 and 1987 catch = 2,079												
Situk	0.0	0.2	0.1	11.6	1.9	0.0	55.8	3.7	0.2	26.1	tr	0.1
Std. Err.	-	0.1	0.1	0.9	0.4	-	1.4	0.5	0.1	1.2	-	0.1
n = 1,584 and 1987 catch = 61,421												
Lost	0.0	2.8	0.0	20.9	1.7	0.0	63.5	1.3	0.0	9.5	0.2	0.0
Std. Err.	-	0.6	-	1.5	0.5	-	1.8	0.4	-	1.1	0.2	-
n = 504 and 1987 catch = 1,976												
Yakutat Bay	0.0	0.8	0.0	44.1	2.0	0.1	51.0	0.2	0.2	1.7	0.0	0.0
Std. Err.	-	0.3	-	1.7	0.5	0.1	1.7	0.1	0.1	0.3	-	-
n = 1,621 and 1987 catch = 24,943												
Manby Shore	0.0	0.0	0.0	11.5	2.8	0.0	83.1	1.1	0.0	1.5	0.0	0.0
Std. Err.	-	-	-	3.2	0.7	-	3.3	0.6	-	0.5	-	-
n = 545 and 1987 catch = 8,057												

River fish in 1987. The CWT analysis also showed that the Situk River fishery was comprised of approximately 27% other stocks in 1987; most of which were likely of Ahrnklin River origin.

The Situk River sockeye salmon run is composed of several individual stocks. In addition to fish that spawn in or near Situk Lake and Mountain Lake, spawning sockeye salmon have also been observed in the Situk River below Situk Lake, in the Old Situk River, along the West Fork, and in Redfield Lake. The spawning stocks in Situk Lake and Mountain Lake are thought to comprise the majority of the run. Partial counts of spawning sockeye in the Situk River below Situk Lake and in the Old Situk River are several thousand in most years. Little is known of the number of sockeye that spawn in the West Fork or in Redfield Lake. The operation of the weir at Mountain Lake in 1988 provided the first enumeration of that stock and it was found that Mountain Lake fish comprised 37% of the total Situk River sockeye run in that year.

The identification of the temporal contribution of individual stocks to a run is important to managers. This information can provide the rationale for increased exploitation or protection of individual stocks. The spaghetti tag study indicated that Mountain Lake fish contributed most heavily to the early portion of the Situk River sockeye salmon run. This data provides an objective tool with which to separately manage that stock. Additionally, age composition data indicates that the majority of the age-2. and age-3. fish in the Situk River run in 1988 were from Mountain Lake.

Accurate estimation of the other sockeye salmon spawning stocks in the Situk drainage has not, to date, been measured. Several methods for estimation exist. A first option, a double weir system, one at the river mouth location and another located just above the Alsek Road, would objectively and directly provide estimation of the spawning population of sockeye salmon in the Old Situk River. A second option would be to use scale patterns to identify individual stocks. Scales collected from the sockeye salmon escapement at the Situk weir could be separated into individual stocks by age class using linear discriminate function analysis or a similar analysis. Scales collected from sockeye salmon spawning in Mountain Lake, in Situk Lake, in the Old Situk River, and in the West Fork could provide the basis for separating the Situk River escapement into these four stock components. Analysis of this type looks promising as Mountain Lake fish are mostly age 2+ and distinctive age 1.2 and 1.3 patterns were encountered while ageing the Situk River scales.

#### RECOMMENDATIONS

1. Continue to operate the Situk River weir near the river mouth to enumerate sockeye salmon spawners and to provide age composition for spawner/recruit and other analysis.
2. Collect scales from sockeye salmon on the spawning grounds at Mountain Lake, Situk Lake, the Old Situk River, and the West Fork to provide standards for scale pattern analysis. Digitize the standards from the spawning grounds and unknowns from the Situk River weir to identify the total and temporal contribution of these four stocks.

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## APPENDIX A

Sockeye salmon smolts in the Situk River were tagged with coded wire tags in 1984 (Kissner 1985). During the summer of 1987, returning sockeye salmon in the Situk River escapement and harvested sockeye salmon in the Situk River and Yakutat Bay set gill net fisheries were sampled for presence of coded wire tags. Marianna Alexandersdottir (Region I Biometrician) analyzed this coded wire tag information in a December 29, 1987, memorandum which was forwarded to Don Ingledue (Juneau Area Management Biologist). This original analysis of the Situk sockeye salmon coded wire tag information is duplicated as Appendix A (Note, the sockeye salmon smolts were tagged in 1984 not 1983 as indicated in the 12/29/87 memorandum).

MEMORANDUM

STATE OF ALASKA.  
Department of Fish and Game.

To: Don Ingledue,  
Area management biologist,  
Juneau.

Date: December 29, 1987

Subject: Situk River Tagging.

From: Marianna Alexandersdotter  
Biometrician.

As you requested these are the results of the analysis of the Situk River sockeye salmon tag recoveries in 1987. In 1983 35,017 sockeye salmon smolts were tagged with coded-wire tags at the mouth of the Situk River over a period of four weeks (5/22-6/55). Of these 31,620 were released with tags and 3,397 (about 10%) were released with clips but had rejected the tags.

During the summer of 1987 tag recoveries were made by sampling personnel in the Situk River (182-70) and Yakutat Bay (18310) fisheries. The Situk River and Yakutat Bay fisheries both occurred later in the season than the mean for 1970-1986 (Figure 1). The point of 50% catch occurred one to two weeks later in both fisheries in 1987. A total of 15,744 sockeye salmon were sampled in the Situk River fishery from a total harvest of 63,294 and 5,849 in the Yakutat Bay fishery from a total catch of 24,934 sockeye salmon. 199 (0.57% of release) tags were found in the Situk River fishery and 57 (0.17%) in the Yakutat Bay fishery. Accounting for sampling effort these numbers expand to a total of 1,071 tags in the Situk River harvest, or a total tag return of 3.06% to that fishery, and 235 tags in the Yakutat Bay harvest for a total of 0.67% of the total release. Two tags were also recovered in the Lost River (182-80) fishery in statweek 31.

The total contributions of Situk River sockeye salmon to each fishery and each statistical week was estimated by;

$$C = N / n_2 \times m_c / r \quad (\text{Clark et.al. 1985}),$$

where,

C = estimated contribution of Situk River fish to fishery i,  
N = total catch of sockeye salmon in fishery i,  
n<sub>2</sub> = sockeye salmon sampled in fishery i,  
m<sub>c</sub> = number of tags observed in sample,  
r = proportion of fish tagged of 1983 outmigrants.

The proportion of fish tagged ( $r$ ) was estimated by the proportion of tags observed in the adult return to the Situk River weir. The daily proportion tagged was estimated by,

$$r = a / (e * p_2),$$

where,

$a$  = number of adipose clipped fish observed,  
 $e$  = number of fish examined for adipose clips,  
 $p_2$  = estimated proportion of 3-ocean fish.

There are several factors which contribute to uncertainty in the estimate of contribution in addition to the sampling error, and which therefore cannot be directly estimated.

(1) Stocks spawning below the weir. These stocks will have been present at the tagging site at the mouth of the river, and therefore represented in the tagged group, but will not be represented at the weir where the proportion of tagged fish was estimated. This is an unknown quantity, as these stocks may not have been equally represented in the tagged and untagged portions of the outmigrants. Since no data exist to investigate this it is assumed in this analysis that all segments of outmigrants passing the site were sampled and tagged in equal proportions and the weir sample used to estimate the percent tagged is representative.

(2) Adipose fin clips. Ten percent of tagged fish were estimated to reject tags prior to release. However the incidence of fish with missing adipose fins in the catch sampled averaged 19.4% in the Situk River fishery and 16.3% in the Yakutat Bay fishery (Figure 2). This could be due to a high incidence of naturally missing adipose fins or to a higher rate of tag rejection than estimated at the time of tagging. Blankenship (1981) in a study on coded wire tag loss found that tag loss continued over as long as a 20-30 day period for coho and chinook salmon. He also observed naturally missing adipose fins to occur in wild stocks at a rate of .03 - .06%. In order to demonstrate how this may affect the estimates, two methods were used to account for the non-tagged fish with missing adipose fins. The first method added 10% to tags observed in the catch before estimating the contribution, which assumes that the additional missing adipose fins were natural. The second method presupposes all adipose fin clipped fish were originally tagged and added all non-tags to the observed tags assuming that tag rejection rates were higher than those recorded in the 24-hour experiment carried out at time of tagging.

## Results.

(1) Estimation of proportion tagged. The total count over the weir was 72,724, 24,274 (or 33%) were examined and 388 were missing adipose fins. The age composition analysis for the Situk River weir (Table 1) was used to estimate the number of 3-ocean fish in those sampled (21,637 or 89%). The daily percent tagged was averaged over all days, with 1.97% tagged on the average ( $\pm 0.3\%$ ). The trend in the distribution over the weeks of clipped fish (corrected for sampling effort) followed that of total escapement, except in week 29, when 22% of clipped fish were observed, but only 8% of the escapement (Figure 3).

(2) Tag recoveries. Tags were recovered in weeks 27 through 32 in the Situk River fishery and weeks 25 to 30 in the Yakutat Bay fishery (Table 2). Four tag codes were used in the tagging over a four week period (Table 2) and tags from all codes were recovered in both fisheries in most weeks. In order to combine these for estimating contributions the assumption must be made that the four tag codes are randomly distributed through-out the Situk River adults returning to the fisheries. A chi-square test was used to test whether each tag code represented the same proportion in the weekly returns as it did at the time of release (Table 2). As these tests were not significant in either fishery (Table 2), the tag codes could be combined for estimating total contributions to each fishery.

(3) Contributions to Situk River and Yakutat Bay fisheries. In the Situk River fishery the percent contributions ranged from 85 - 100% in weeks 29 through 31, but less in the first two weeks (27 and 28) and the last week (32) (Table 3, Figure 4). The lower contribution found in these weeks may be due to the presence of stocks in the fishery that did not migrate past the tagging site in 1983. The frequency of non-tagged fish with missing adipose fins was high in the Situk fishery in all weeks (Figure 1), 16-20% of all adipose clipped fish, and 0.32% of all fish sampled. The second estimate of contribution is consistently higher (Figure 4), but both are within the combined range of the 95% confidence intervals.

In Yakutat Bay the frequency of non-tagged fish with missing adipose fins was lower than in the Situk River fishery in the early weeks, but increased to 20% of adipose fin clipped fish in weeks 29 and 30 (Figure 1), when Situk River contributions to Yakutat Bay fishery were higher (Figure 5). Overall 16% of the fish with missing adipose fins were not tagged and 0.2% of all fish sampled. The two point estimates of contribution are within the combined 95% confidence intervals (Table 3, Figure 5), and the large apparent discrepancy in week 30 is due to small sample sizes and large sampling error. The percent contribution was lower (15-70%) in earlier weeks, but ranged from 50-100% in weeks 28 to 30 (Figure 5).

These results do indicate that Situk River fish contribute a sizeable portion of the Yakutat Bay sockeye salmon harvest, with a total contribution for the season estimated at around 50% (Table 3). The variability between weeks can be explained by the presence of other non-Situk River stocks, but there is also a certain amount of uncertainty inherent in these estimates. This uncertainty is due to factors discussed above, including the high incidence of non-tagged fish with missing adipose fins, the fact that the percent tagged is estimated from adult returns to the weir and the presence of tagged fish spawning below the weir.

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cc. Paul Larson,  
Dave Cantillon.

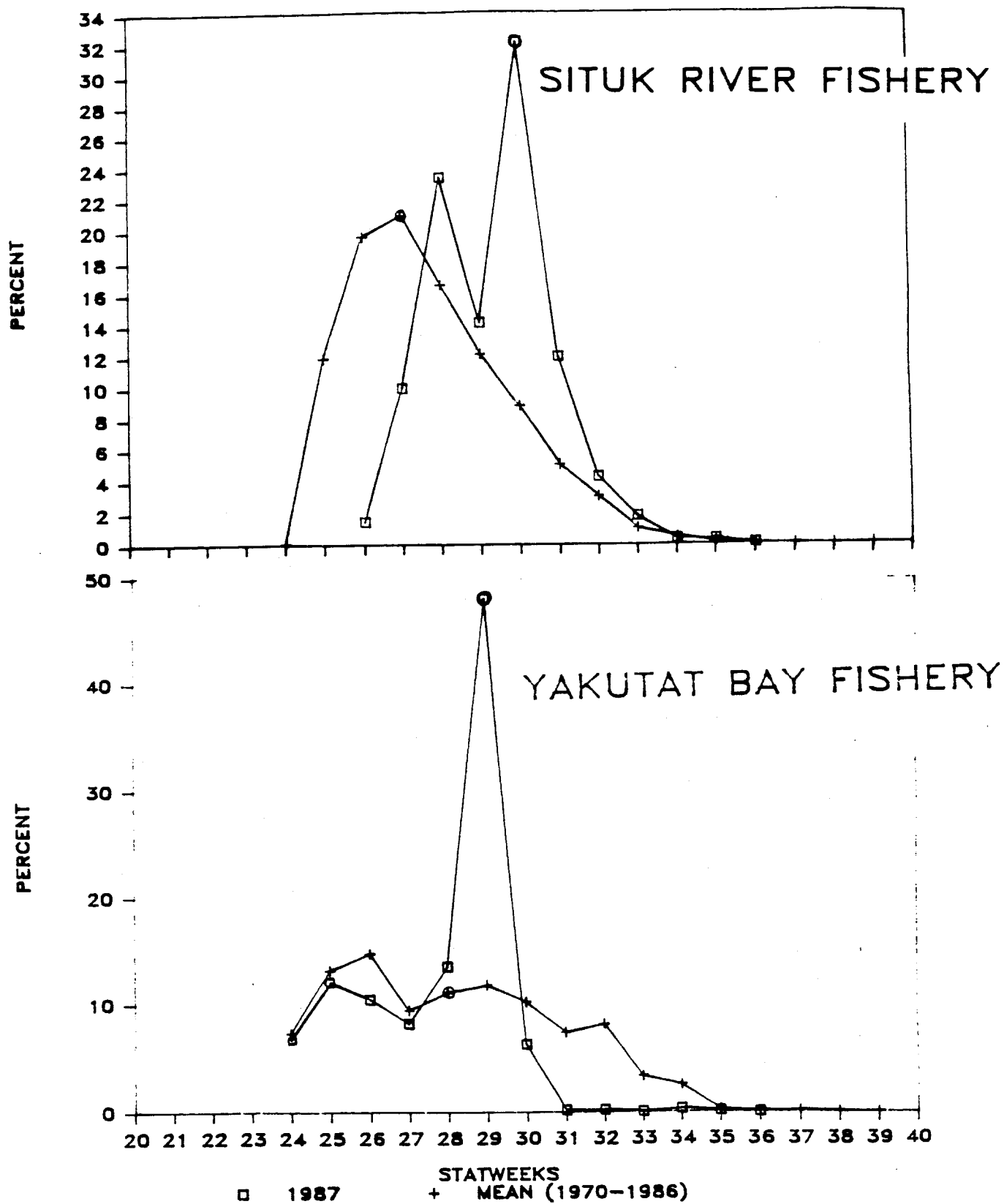


Figure one. Percent distribution of catch in Situk River and Yakutat Bay, for 1987 and mean for 1970-1986.

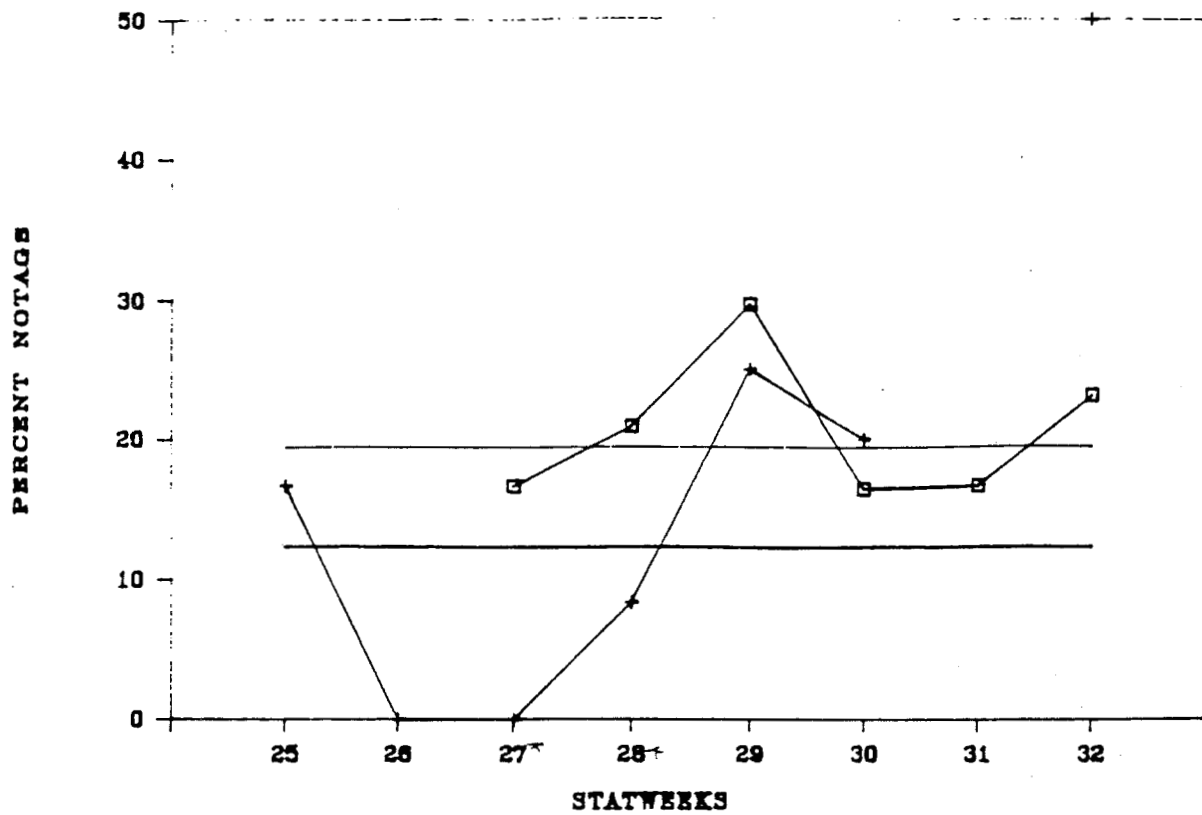


Figure two. Percent of total adipose fin-clipped fish with no tags in Situk River (□) and Yakutat Bay (+) fisheries.



# SITUK RIVER WEIR 1987

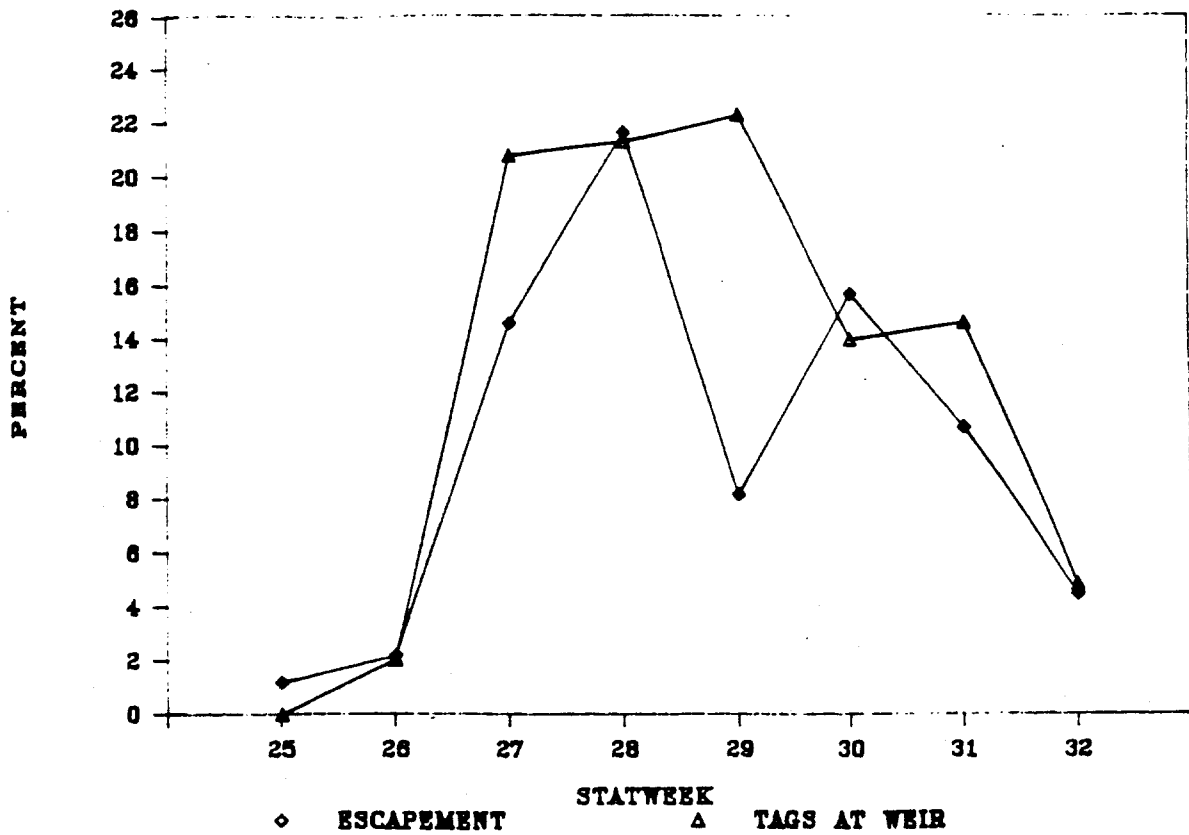
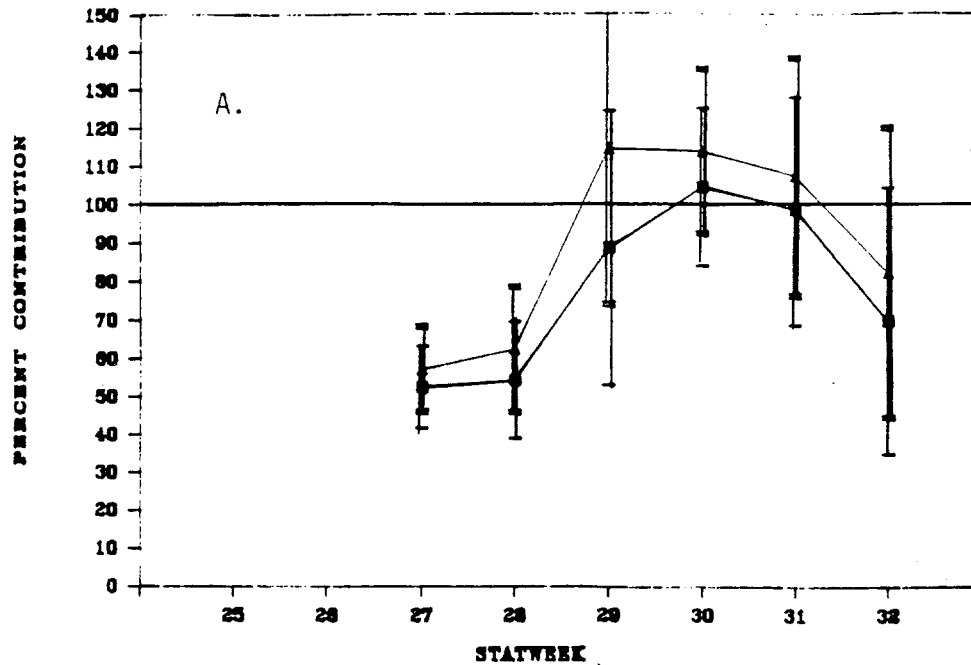


Figure three. Percent distribution of total escapement and adipose fin-clipped sockeye salmon and Situk River weir, 1987.

# SITUK RIVER FISHERY CONTRIBUTIONS



## PERCENT DISTRIBUTION OVER STATWEEKS

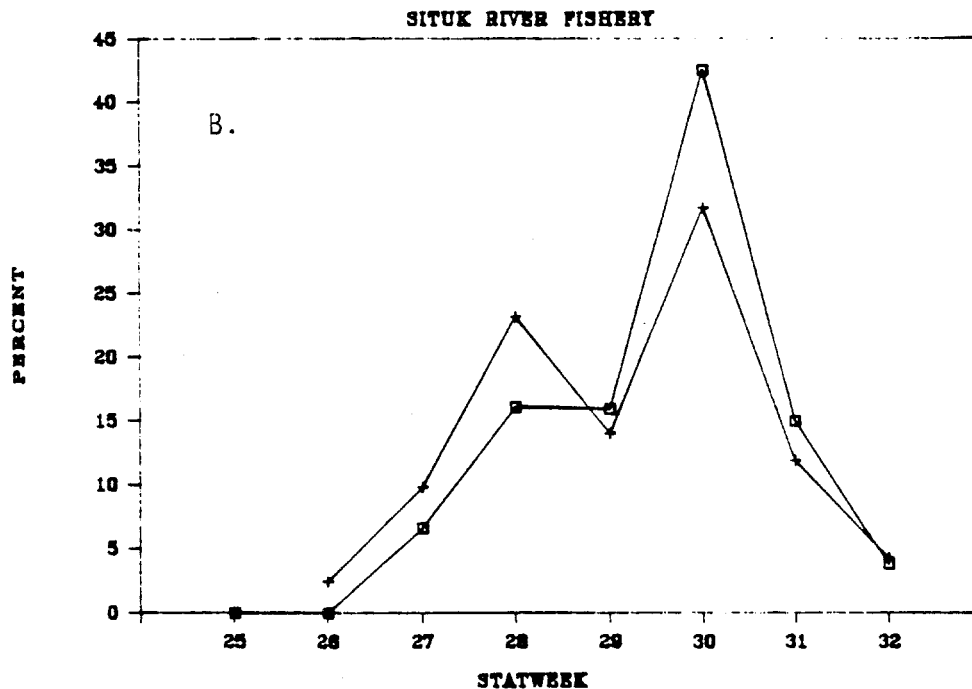
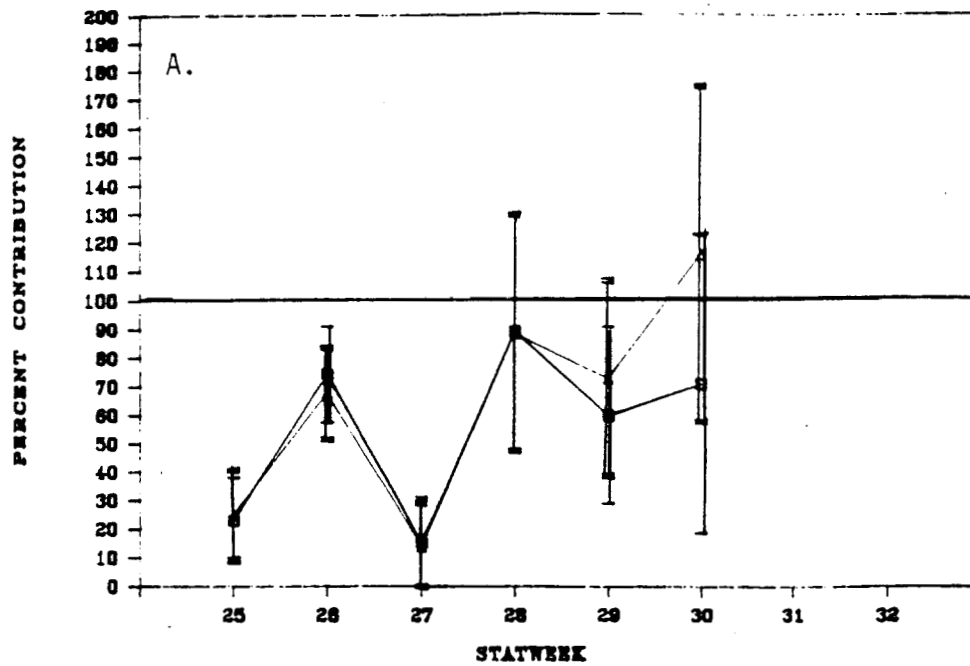


Figure four. Situk River Fishery contributions.

A. Percent contribution of tagged Situk River stocks to total harvest, calculated using two methods. 1- 10% added to tags found ( ), and 2 - all adipose fin clipped sockeye salmon included ( ). Bars indicate 95% confidence intervals.

B. Percent distribution over statistical weeks of total harvest ( ) and tagged Situk River stocks contribution ( ).

## YAKUTAT BAY FISHERY CONTRIBUTIONS



## PERCENT DISTRIBUTION OVER STATWEEKS

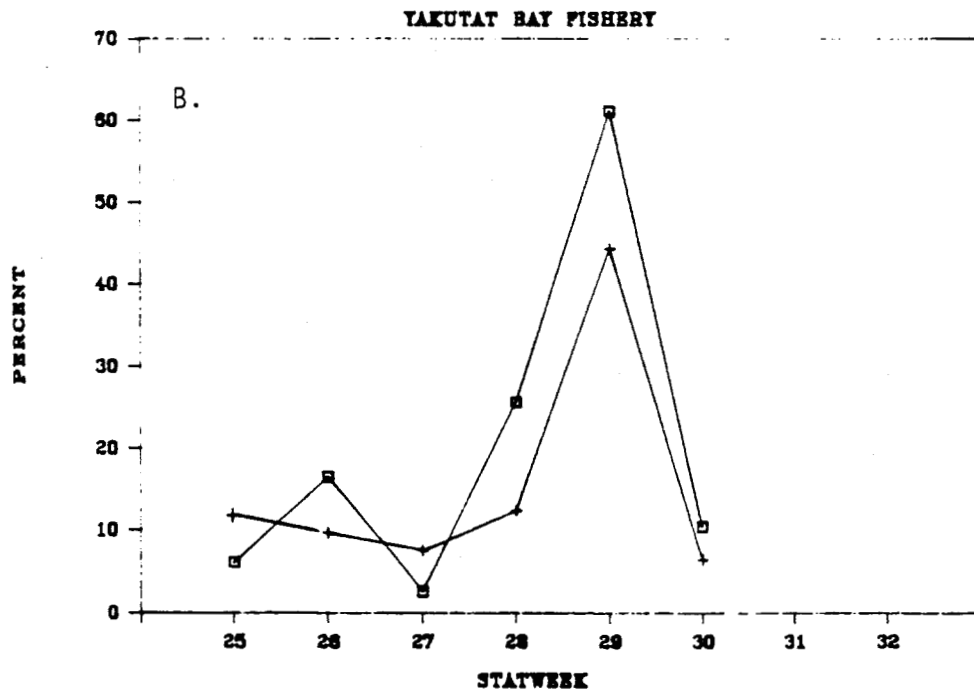


Figure five. Yakutat Bay fishery contributions.

- A. Percent contribution of tagged Situk River stocks to total harvest, calculated using two methods. 1 - 10% added to tags found ( ), and 2 - all adipose fin clipped sockeye salmon included ( ). Bars indicate 95% confidence intervals.
- B. Percent distribution over statistical weeks of total harvest ( ) and tagged Situk River stocks contribution ( ).

Table 1. Age composition of sockeye salmon in the Situk River escapement, 1987.

		Brood Year and Age Class											
		1984	1983	1983	1983	1982	1982	1982	1981	1981	1981	1980	
		2.0	0.3	1.2	2.1	1.3	2.2	3.1	1.4	2.3	3.2	3.3	Total
Statistical Weeks	25 - 27	(June 14 - July 4)											
All Fish													
Sample Number				8		136	14			28			188
Percent				4.3		73.1	7.5			15.1			100.0
Std. Error				1.5		3.3	1.9			2.6			
Number				620		10543	1085			2171			14419
Statistical Week	28	(July 5 - 11)											
All Fish													
Sample Number				3		91	6		4	17	1		122
Percent				2.5		74.6	4.9		3.3	13.9	0.8		100.0
Std. Error				1.4		4.0	2.0		1.6	3.1	0.8		
Number				407		12345	814		543	2306	136		16551
Statistical Week	29	(July 12 - 18)											
All Fish													
Sample Number			1	11		87	6		1	7			113
Percent			0.9	9.7		77.0	5.3		0.9	6.2			100.0
Std. Error			0.9	2.8		4.0	2.1		0.9	2.3			
Number			69	756		5978	412		69	481			7765
Statistical Week	30	(July 19 - 25)											
All Fish													
Sample Number			5	5		105	2			16		1	134
Percent			3.7	3.7		78.4	1.5			11.9		0.7	100.0
Std. Error			1.6	1.6		3.6	1.1			2.8		0.7	
Number			518	518		10875	207			1657		104	13879
Statistical Week	31	(July 26 - August 1)											
All Fish													
Sample Number			1	5		81	5			27			119
Percent			0.8	4.2		68.1	4.2			22.7			100.0
Std. Error			0.8	1.8		4.3	1.8			3.9			
Number			75	374		6060	374			2020			8903
Statistical Week	32	(August 2 - 8)											
All Fish													
Sample Number			1	4	2	95	9			31			142
Percent			0.7	2.8	1.4	66.9	6.3			21.8			100.0
Std. Error			0.7	1.4	1.0	4.0	2.1			3.5			
Number			46	186	93	4413	418			1440			6597
Statistical Weeks	33 - 34	(August 9 - 22)											
All Fish													
Sample Number		1		6		84	13	2		20			126
Percent		0.8		4.8		66.7	10.3	1.6		15.9			100.0
Std. Error		0.8		1.9		4.2	2.7	1.1		3.3			
Number		37		219		3071	475	73		731			4606
Combined Periods (Percentages are weighted by period escapements)													
Male													
Sample Number			5	21	2	324	25	1	1	58	1		438
Percent			0.6	2.3	0.1	33.1	2.5	0.1	0.2	5.4	0.2		44.6
Std. Error			0.3	0.5	0.1	1.6	0.5	0.1	0.2	0.8	0.2		1.7
Number			454	1661	93	24098	1852	37	136	3955	136		32421
Female													
Sample Number		1	3	21		355	30	1	4	88		1	504
Percent		0.1	0.3	2.0		40.1	2.7	0.1	0.7	9.4		0.1	55.4
Std. Error		0.1	0.2	0.4		1.7	0.5	0.1	0.3	1.0		0.1	1.7
Number		37	254	1419		29188	1934	37	476	6851		104	40299
All Fish													
Sample Number		1	8	42	2	679	55	2	5	146	1	1	942
Percent		0.1	1.0	4.2	0.1	73.3	5.2	0.1	0.8	14.9	0.2	0.1	100.0
Std. Error		0.1	0.3	0.7	0.1	1.5	0.7	0.1	0.4	1.2	0.2	0.1	
Number		37	708	3080	93	53286	3786	73	611	10806	136	104	72720

Table 2. Releases and recoveries for Situk River sockeye salmon by tag code.

	T a g C o d e s				
	4-24-2	4-24-3	4-24-3	4-24-9	Total
Tag releases					
Released with tags	9718	9625	2477	9800	31620
Clipped, no tags	1044	1034	266	1053	3397
Percent of total	30.7	30.4	7.8	31.0	
Tag recoveries					
Situk River fishery (ns)	52	61	13	71	199
Percent	26.1	30.7	6.5	35.7	
Yakutat Bay fishery (ns)	17	13	10	17	57
Percent	29.8	22.8	17.5	29.8	

(ns) = chi-square test not significant

Table 3. Contribution of Situk River sockeye salmon to Situk River and Yakutat Bay fisheries 1987.

	S t a t w e e k								
	25	26	27	28	29	30	31	32	Total
Situk River fishery - 18270									
Tags recovered			35.0	34.0	19.0	71.0	30.0	10.0	199.0
+ 10% (1)			38.5	37.4	20.9	78.1	33.0	11.0	218.9
+ non-tags (2) <i>all adyose</i>			42.0	43.0	27.0	85.0	36.0	13.0	246.0
Total sampled		919	3730	3502	1196	3874	1701	803	15744
Harvest		1527	6248	14697	8877	20102	7532	2690	63294
Contribution (1)			3273.48	7967.91	7874.10	21043.39	7417.46	1870.56	49446.90
Percent			52.39	54.21	88.70	104.68	98.48	69.54	78.12
Contribution (2)			3571.07	9160.96	10172.28	22902.54	8091.78	2210.66	56109.29
Percent			57.16	62.33	114.59	113.93	107.43	82.18	88.65
Yakutat Bay fishery - 18310									
Tags recovered	5.00	22.00	2.00	11.00	12.00	5.00	*		30.00
+ 10% (1)	5.50	24.20	2.20	12.10	13.20	5.50			33.00
+ non-tags (2)	6.00	22.00	2.00	12.00	16.00	7.00			37.00
Total sampled	1211	1652	734	740	1118	394			5849
Harvest	2891.00	2412.00	1884.00	3120.00	11071.00	1594.00			24934.00
Contribution (1)	666.42	1793.50	286.67	2789.14	6635.51	1129.51			10840.83
Percent	23.05	74.36	15.22	89.40	59.94	70.86			43.48
Contribution (2)	727.01	1630.46	260.61	2766.09	8043.05	1851.27			12921.02
Percent	25.15	67.60	13.83	88.66	72.65	116.14			51.82

## APPENDIX B

Appendix Tables B-1 through B-12 provide detailed summaries of the age and length composition of sockeye salmon in the Situk River fishery, in the Situk River escapement, and in the Mountain Lake escapement during various sampling periods of 1988 and tests for significant differences among these time periods.

Appendix Table B-1. Age composition of sockeye salmon in the District 182-70 Situk River set gill net catch by sex and weekly fishing period, 1988.

Week	Percent Age Composition by Brood Year and Age											Total
	1985	1984			1983			1982			1981	
	0.2	0.3	1.2	2.1	0.4	1.3	2.2	1.4	2.3	3.2	3.3	
<b>26</b>	1.4	6.9	19.8	0.0	1.4	28.6	18.9	0.5	18.0	4.1	0.5	100.0
SE	0.8	1.7	2.6	-	0.8	3.0	2.6	0.4	2.5	1.3	0.4	-
n	3	15	43	0	3	62	41	1	39	9	1	217
<b>27</b>	0.4	11.2	18.8	0.0	0.0	30.4	11.6	0.8	24.8	2.0	0.0	100.0
SE	0.4	2.0	2.4	-	-	2.9	2.0	0.6	2.7	0.9	-	-
n	1	28	47	0	0	76	29	2	62	5	0	250
<b>28</b>	2.1	20.7	12.8	0.0	0.0	33.1	9.9	0.4	17.6	3.7	0.0	100.0
SE	0.9	2.6	2.1	-	-	3.0	1.9	0.4	2.4	1.2	-	-
n	5	50	31	0	0	80	24	1	42	9	0	242
<b>29</b>	0.4	12.6	10.5	0.0	0.8	32.0	13.4	0.8	24.7	4.5	0.4	100.0
SE	0.4	2.1	1.9	-	0.6	3.0	2.2	0.6	2.7	1.3	0.4	-
n	1	31	26	0	2	79	33	2	61	11	1	247
<b>30</b>	0.5	13.1	15.8	0.0	0.0	28.8	12.2	0.9	25.7	3.2	0.0	100.0
SE	0.4	2.2	2.4	-	-	3.0	2.2	0.6	2.9	1.2	-	-
n	1	29	35	0	0	64	27	2	57	7	0	222
<b>31</b>	0.0	16.0	19.1	1.1	0.0	25.5	11.7	0.0	21.3	5.3	0.0	100.0
SE	-	3.7	3.9	1.0	-	4.4	3.2	-	4.1	2.2	-	-
n	0	15	18	1	0	24	11	0	20	5	0	94
<b>32</b>	5.3	25.4	18.9	0.0	0.0	16.0	17.2	0.0	15.4	1.8	0.0	100.0
SE	1.6	3.2	2.9	-	-	2.7	2.8	-	2.6	1.0	-	-
n	9	43	32	0	0	27	29	0	26	3	0	169
Combined Periods (Percentages are weighted by period catches)												
<b>Male</b>	0.7	5.8	5.9	0.0	tr	12.8	6.2	0.5	9.8	2.3	tr	44.0
SE	0.2	0.7	0.7	-	-	1.0	0.7	0.2	0.9	0.5	-	1.5
n	14	87	96	0	1	176	101	5	138	30	1	649
<b>Female</b>	0.3	8.6	8.6	tr	0.3	17.9	6.2	0.2	12.5	1.2	0.1	56.0
SE	0.1	0.8	0.8	-	0.2	1.2	0.7	0.1	1.0	0.3	0.1	1.5
n	6	123	136	1	4	236	93	3	168	19	1	790
<b>All</b>	1.0	14.4	14.5	tr	0.3	30.7	12.4	0.7	22.3	3.5	0.2	100.0
SE	0.3	1.0	1.0	-	0.2	1.4	1.0	0.2	1.2	0.6	0.1	-
n	20	211	232	1	5	412	194	8	307	49	2	1,441



Appendix Table B-2. Tests for significant differences in the age composition of sockeye salmon caught in the Situk River fishery between seven weekly fishing periods.

	Brood Year and Age Class										
	1985	1984			1983			1982			1981
Weeks Compared	0.2	0.3	1.2	2.1	0.4	1.3	2.2	1.4	2.3	3.2	3.3
26 versus 27							S*		S		
26 versus 28		S**	S				S**				
26 versus 29		S	S**								
26 versus 30		S*					S		S		
26 versus 31		S*									
26 versus 32	S	S**				S**					
27 versus 28		S**	S						S		
27 versus 29			S*								
27 versus 30											
27 versus 31											
27 versus 32	S**	S**				S**			S*		
28 versus 29		S*							S		
28 versus 30		S*							S*		
28 versus 31											
28 versus 32						S**	S*				
29 versus 30											
29 versus 31			S								
29 versus 32	S**	S**	S*			S**			S*		
30 versus 31											
30 versus 32	S**	S**				S**			S*		
31 versus 32	S					S					

S = significant at probabilities = 0.10.  
S\* = significant at probabilities = 0.05.  
S\*\* = significant at probabilities = 0.01.

Appendix Table B-3. Average length of sockeye salmon in the District 182-70 Situk River set gill net catch by sex, age class, and fishing period, 1988.

Week	Average Length (mm) by Brood Year and Age									
	1985	1984		1983			1982		1981	
	0.2	0.3	1.2	0.4	1.3	2.2	1.4	2.3	3.2	3.3
<b>26</b>	480	577	460	-	537	488	-	548	476	590
SE	-	8.8	12.8	-	4.3	8.2	-	7.8	8.9	-
n	1	3	13	0	18	9	0	11	5	1
<b>27</b>	-	564	518	-	560	496	600	568	-	-
SE	-	6.5	7.4	-	5.7	7.8	15.0	6.3	-	-
n	0	9	8	0	24	7	2	14	0	0
<b>28</b>	495	568	507	-	569	521	-	559	580	-
SE	-	8.5	12.1	-	4.2	11.8	-	5.5	-	-
n	1	17	10	0	19	4	0	13	1	0
<b>29</b>	-	578	508	600	578	496	635	572	515	-
SE	-	16.9	5.0	-	6.9	7.5	-	7.1	20.2	-
n	0	4	12	1	22	8	1	12	3	0
<b>30</b>	-	582	524	-	591	528	-	578	555	-
SE	-	9.8	6.4	-	6.6	7.6	-	5.8	-	-
n	0	7	11	0	18	12	0	17	1	0
<b>31</b>	-	580	534	-	587	524	-	571	555	-
SE	-	9.7	18.0	-	11.4	11.0	-	6.2	-	-
n	0	8	6	0	6	6	0	5	1	0
<b>32</b>	535	573	523	-	574	529	-	583	-	-
SE	20.0	8.7	8.7	-	14.9	9.7	-	7.3	-	-
n	3	12	9	0	9	10	0	12	0	0
Combined Periods (Percentages are weighted by period catches)										
<b>Male</b>	535	584	516	-	579	520	625	574	525	590
SE	20.0	7.0	5.7	-	4.8	4.7	10.0	4.0	14.3	-
n	3	23	32	0	55	35	2	43	8	1
<b>Female</b>	488	566	499	600	559	499	585	563	471	-
SE	7.5	3.8	7.1	-	3.2	6.3	-	3.6	13.7	-
n	2	37	37	1	61	21	1	41	3	0
<b>All</b>	516	573	507	600	569	512	612	569	510	590
SE	16.2	3.7	4.7	-	3.0	4.0	14.5	2.7	13.1	1
n	5	60	69	1	116	56	3	84	11	1

Appendix Table B-4. Tests for significant differences in the average length of sockeye salmon caught in the Situk River fishery between seven weekly fishing periods.

Weeks Compared	Brood Year and Age Class								
	1985	1984		1983			1982		1981
	0.2	0.3	1.2	0.4	1.3	2.2	1.4	2.3	3.2 3.3
26 versus 27			S**		S**			S*	
26 versus 28			S**		S**	S*			
26 versus 29			S**		S**			S*	S
26 versus 30			S**		S**	S**		S**	
26 versus 31			S**		S**	S**		S*	
26 versus 32			S**		S*	S**		S**	
27 versus 28						S			
27 versus 29					S*				
27 versus 30					S**	S**			
27 versus 31					S*	S*			
27 versus 32						S**			
28 versus 29						S			
28 versus 30					S**			S*	
28 versus 31									
28 versus 32								S**	
29 versus 30			S*			S**			
29 versus 31						S*			
29 versus 32						S**			
30 versus 31									
30 versus 32									
31 versus 32									

S = significant at probabilities = 0.10.

S\* = significant at probabilities = 0.05.

S\*\* = significant at probabilities = 0.01.

Appendix Table B-5. Age composition of sockeye salmon in the Situk River escapement by sex and sampling period, 1988.<sup>1</sup>

	Percent Age Composition by Brood Year and Age													
	1985		1984			1983		1982			1981			
Period	0.2	1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total	
1														
Male	3.0	0.0	0.8	12.4	0.0	8.6	19.5	0.0	13.9	5.3	0.8	0.8	65.0	
SE	1.0	-	0.5	2.0	-	1.7	2.4	-	2.1	1.4	0.5	0.5	2.9	
n	8	0	2	33	0	23	52	0	37	14	2	2	173	
Female	0.0	0.0	0.4	8.6	0.0	8.3	9.8	0.0	5.6	1.9	0.0	0.4	35.0	
SE	-	-	0.4	1.7	-	1.7	1.8	-	1.4	0.8	-	0.4	2.9	
n	0	0	1	23	0	22	26	0	15	5	0	1	93	
All	3.0	0.0	1.1	21.1	0.0	16.9	29.3	0.0	19.5	7.1	0.8	1.1	100.0	
SE	1.0	-	0.6	2.5	-	2.3	2.8	-	2.4	1.6	0.5	0.6	-	
n	8	0	3	56	0	45	78	0	52	19	2	3	266	
2														
Male	0.3	0.0	0.6	11.1	0.0	15.0	11.8	0.0	17.8	4.1	0.0	0.3	61.1	
SE	0.3	-	0.4	1.8	-	2.0	1.8	-	2.1	1.1	-	0.3	2.7	
n	1	0	2	35	0	47	37	0	56	13	0	1	192	
Female	1.0	0.0	0.3	6.4	0.0	8.3	8.9	0.0	10.5	3.5	0.0	0.0	38.9	
SE	0.5	-	0.3	1.4	-	1.5	1.6	-	1.7	1.0	-	-	2.7	
n	3	0	1	20	0	26	28	0	33	11	0	0	122	
All	1.3	0.0	1.0	17.5	0.0	23.2	20.7	0.0	28.3	7.6	0.0	0.3	100.0	
SE	0.6	-	0.5	2.1	-	2.4	2.3	-	2.5	1.5	-	0.3	-	
n	4	0	3	55	0	73	65	0	89	24	0	1	314	
3														
Male	0.0	0.5	0.0	11.5	0.9	9.6	8.7	0.5	17.9	3.7	0.0	0.5	53.7	
SE	-	0.5	-	2.1	0.6	2.0	1.9	0.5	2.6	1.3	-	0.5	3.4	
n	0	1	0	25	2	21	19	1	39	8	0	1	117	
Female	0.5	0.0	0.0	11.5	0.0	6.9	9.6	0.0	12.4	5.5	0.0	0.0	46.3	
SE	0.5	-	-	2.1	-	1.7	2.0	-	2.2	1.5	-	-	3.4	
n	1	0	0	25	0	15	21	0	27	12	0	0	101	
All	0.4	0.4	0.0	22.5	0.7	17.5	21.1	0.4	27.6	8.7	0.0	0.7	100.0	
SE	0.4	0.4	-	2.5	0.5	2.3	2.4	0.4	2.7	1.7	-	0.5	-	
n	1	1	0	62	2	48	58	1	76	24	0	2	275	
1-3														
Male	1.2	0.1	0.5	11.7	0.2	11.3	13.9	0.1	16.4	4.4	0.3	0.5	60.7	
SE	0.4	0.1	0.2	1.1	0.2	1.1	1.2	0.1	1.3	0.7	0.2	0.3	1.7	
n	9	1	4	93	2	91	108	1	132	35	2	4	482	
Female	0.5	0.0	0.3	8.5	0.0	7.9	9.4	0.0	9.2	3.4	0.0	0.1	39.3	
SE	0.2	-	0.2	1.0	-	0.9	1.0	-	1.0	0.6	-	0.1	1.7	
n	4	0	2	68	0	63	75	0	75	28	0	1	316	
All	1.6	0.1	0.7	20.2	0.2	19.3	23.8	0.1	25.1	7.8	0.3	0.7	100.0	
SE	0.4	0.1	0.3	1.4	0.1	1.3	1.5	0.1	1.5	0.9	0.2	0.3	-	
n	13	1	6	173	2	166	201	1	217	67	2	6	855	

<sup>1</sup> Period 1 = 6/7-7/3 (sample date = 6/29; Period 2 = 7/4-7/21 (sample dates = 7/14 & 7/17); and, Period 3 = 7/22-8/21 (sample date = 7/28).

Appendix Table B-6. Tests for significant differences in the age composition of sockeye salmon in the Situk River escapement between three sampling periods.

Brood Year	Age Class	Period One versus Period Two	Period One versus Period Three	Period Two versus Period Three
1985	0.2		S*	
	1.1			
1984	0.3			
	1.2			
	2.1			
1983	1.3	S		
	2.2	S*	S*	
1982	1.4			
	2.3	S*	S*	
	3.2			
1981	2.4			
	3.3			

S = significant at probabilities = 0.10.  
S\* = significant at probabilities = 0.05.  
S\*\* = significant at probabilities = 0.01.

Appendix Table B-7. Average length of sockeye salmon in the Situk River escapement by sex, age, and sampling period, 1988.<sup>1</sup>

	Average Length (mm) by Brood Year and Age												
	1985		1984			1983		1982			1981		
Period	0.2	1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
1													
Male	443	-	540	443	-	556	468	-	549	473	555	545	495
SE	15.3	-	-	6.9	-	12.8	5.8	-	6.5	9.7	25.0	5.0	4.8
n	8	0	2	33	0	23	49	0	37	14	2	2	170
Female	-	-	430	429	-	526	461	-	540	466	-	540	482
SE	-	-	-	9.3	-	8.7	6.9	-	4.1	8.1	-	-	5.8
n	0	0	1	23	0	22	26	0	15	5	0	1	93
All	443	-	503	437	-	542	466	-	546	471	555	543	490
SE	15.3	-	36.7	5.6	-	8.0	4.5	-	4.8	7.4	25.0	3.3	3.7
n	8	0	3	56	0	45	75	0	52	19	2	3	263
2													
Male	400	-	510	514	-	563	500	-	579	515	-	560	542
SE	-	-	70.0	8.8	-	6.4	7.0	-	6.5	10.4	-	-	4.1
n	1	0	2	35	0	47	37	0	56	13	0	1	192
Female	520	-	560	494	-	549	502	-	548	505	-	-	525
SE	20.0	-	-	8.3	-	8.8	4.3	-	6.4	4.3	-	-	3.8
n	3	0	1	20	0	26	28	0	33	11	0	0	122
All	490	-	527	507	-	558	501	-	568	511	-	560	535
SE	33.2	-	43.7	6.4	-	5.2	4.3	-	5.0	5.9	-	-	2.9
n	4	0	3	55	0	73	65	0	89	24	0	1	314
3													
Male	-	310	-	527	375	580	519	630	584	543	-	620	553
SE	-	-	-	6.3	15.0	6.7	6.6	-	5.6	11.3	-	-	5.0
n	0	1	0	25	2	21	19	1	39	8	0	1	117
Female	490	-	-	494	-	569	496	-	557	511	-	-	524
SE	-	-	-	4.2	-	7.0	9.1	-	4.1	7.7	-	-	4.2
n	1	0	0	25	0	15	21	0	27	12	0	0	101
All	490	310	-	511	375	575	509	630	570	520	-	590	539
SE	-	-	-	4.1	15.0	4.4	4.9	-	3.8	6.7	-	30.0	3.4
n	1	1	0	62	2	48	58	1	76	24	0	2	218
1-3													
Male	438	310	525	492	375	565	489	630	572	505	555	568	528
SE	14.3	-	29.9	5.8	15.0	4.9	4.3	-	3.9	7.6	25.0	18.0	2.9
n	9	1	4	93	2	91	105	1	132	35	2	4	479
Female	513	-	495	472	-	546	486	-	550	501	-	540	512
SE	16.0	-	65.0	5.6	-	5.4	4.4	-	3.3	5.0	-	-	2.8
n	4	0	2	68	0	63	75	0	75	28	0	1	316
All	461	310	515	486	375	558	490	630	563	503	555	562	521
SE	14.6	-	26.0	4.0	15.0	3.5	2.9	-	2.8	4.5	25.0	12.2	2.1
n	13	1	6	173	2	166	198	1	217	67	2	6	795

<sup>1</sup> Period 1 = 6/7-7/3 (sample date = 6/29; Period 2 = 7/4-7/21 (sample dates = 7/14 & 7/17); and, Period 3 = 7/22-8/21 (sample date = 7/28.

Appendix Table B-8. Tests for significant differences in the average length of sockeye salmon in the Situk River escapement between three sampling periods.

Brood Year	Age Class	Period One versus Period Two	Period One versus Period Three	Period Two versus Period Three
1985	0.2			
	1.1			
1984	0.3			
	1.2	S**	S**	
	2.1			
1983	1.3	S	S**	S*
	2.2	S**	S**	
1982	1.4			
	2.3	S**	S**	
	3.2	S**	S**	
1981	2.4			
	3.3			

S = significant at probabilities = 0.10.  
S\* = significant at probabilities = 0.05.  
S\*\* = significant at probabilities = 0.01.

Appendix Table B-9. Age composition of sockeye salmon in the Mountain Lake escapement by sex and sampling period, 1988.<sup>1</sup>

Percent Age Composition by Brood Year and Age										
	1984		1983			1982		1981		
Period	1.2	2.1	1.3	2.2	3.1	2.3	3.2	2.4	3.3	Total
1										
Male	1.5	0.0	3.1	25.4	0.0	10.0	3.8	0.0	0.0	43.8
SE	1.1	-	1.5	3.8	-	2.6	1.7	-	-	4.3
n	2	0	4	33	0	13	5	0	0	57
Female	0.8	0.0	0.8	33.1	0.0	16.9	3.8	0.0	0.8	56.2
SE	0.8	-	0.8	4.1	-	3.3	1.7	-	0.8	4.3
n	1	0	1	43	0	22	5	0	1	73
All	2.3	0.0	3.8	58.0	0.0	26.7	8.4	0.0	0.8	100.0
SE	1.3	-	1.7	4.3	-	3.9	2.4	-	0.8	-
n	3	0	5	76	0	35	11	0	1	131
2										
Male	0.7	0.0	1.4	23.9	0.0	19.6	3.6	0.0	0.7	50.0
SE	0.7	-	1.0	3.6	-	3.3	1.6	-	0.7	4.2
n	1	0	2	33	0	27	5	0	1	69
Female	1.4	0.0	1.4	21.0	0.0	13.8	10.9	0.7	0.7	50.0
SE	1.0	-	1.0	3.4	-	2.9	2.6	0.7	0.7	4.2
n	2	0	2	29	0	19	15	1	1	69
All	2.2	0.0	2.9	44.9	0.0	33.3	14.5	0.7	1.4	100.0
SE	1.2	-	1.4	4.2	-	4.0	3.0	0.7	1.0	-
n	3	0	4	62	0	46	20	1	2	138
3										
Male	0.9	0.0	0.9	14.8	0.9	23.1	5.6	0.9	0.9	48.1
SE	0.9	-	0.9	3.4	0.9	4.0	2.2	0.9	0.9	4.7
n	1	0	1	16	1	25	6	1	1	52
Female	0.0	0.9	0.0	14.8	0.0	27.8	8.3	0.0	0.0	51.9
SE	-	0.9	-	3.4	-	4.3	2.6	-	-	4.7
n	0	1	0	16	0	30	9	0	0	56
All	0.9	0.9	0.9	29.6	0.9	50.9	13.9	0.9	0.9	100.0
SE	0.9	0.9	0.9	4.3	0.9	4.7	3.3	0.9	0.9	-
n	1	1	1	32	1	55	15	1	1	108
1-3										
Male	1.2	0.0	2.2	23.1	0.2	15.2	4.1	0.2	0.4	46.5
SE	0.6	-	0.9	2.3	0.2	1.8	1.1	0.2	0.3	2.7
n	4	0	7	82	1	65	16	1	2	178
Female	0.8	0.2	0.8	26.2	0.0	17.9	6.8	0.2	0.6	53.5
SE	0.5	0.2	0.5	2.5	-	2.1	1.3	0.2	0.5	2.7
n	3	1	3	88	0	71	29	1	2	198
All	2.0	0.2	3.0	49.1	0.2	33.0	11.2	0.4	1.0	100.0
SE	0.8	0.2	1.0	2.7	0.2	1.7	2.5	0.3	0.5	-
n	7	1	10	170	1	136	46	2	4	377

<sup>1</sup> Period 1 = 7/2-7/23 (sample dates = 7/5-7/20; Period 2 = 7/24-8/13 (sample dates = 7/29-8/12); and, Period 3 = 8/14-9/6 (sample dates = 8/17-8/30.



Appendix Table B-10. Tests for significant differences in the age composition of sockeye salmon in the Mountain Lake escapement between three sampling periods.

Brood Year	Age Class	Period One versus Period Two	Period One versus Period Three	Period Two versus Period Three
1984	1.2			
	2.1			
1983	1.3			
	2.2	S*	S**	S*
	3.1			
1982	2.3		S**	S**
	3.2			
1981	2.4			
	3.3			

S = significant at probabilities = 0.10.  
S\* = significant at probabilities = 0.05.  
S\*\* = significant at probabilities = 0.01.

Appendix Table B-11. Average length of sockeye salmon in the Mountain Lake escapement by sex, age, and sampling period, 1988.<sup>1</sup>

	Average Length (mm) by Brood Year and Age									
	1984		1983			1982		1981		
Period	1.2	2.1	1.3	2.2	3.1	2.3	3.2	2.4	3.3	Total
1										
Male	468	-	564	469	-	566	485	-	-	499
SE	12.5	-	16.6	5.4	-	7.9	5.0	-	-	6.9
n	2	0	4	33	0	13	5	0	0	57
Female	450	-	465	480	-	531	493	-	530	497
SE	-	-	-	4.3	-	8.7	9.4	-	-	4.6
n	1	0	1	43	0	22	5	0	1	73
All	462	-	544	476	-	544	492	-	530	498
SE	9.3	-	23.6	3.4	-	6.8	5.5	-	-	4.0
n	3	0	5	76	0	35	11	0	1	130
2										
Male	465	-	598	489	-	569	498	-	530	525
SE	-	-	2.5	5.8	-	6.2	14.2	-	-	6.2
n	1	0	2	33	0	27	5	0	1	69
Female	485	-	568	484	-	530	495	530	530	503
SE	25.0	-	7.5	5.0	-	6.7	4.9	-	-	4.1
n	2	0	2	29	0	19	15	1	1	69
All	478	-	583	487	-	553	496	530	530	514
SE	15.9	-	9.2	3.9	-	5.4	4.9	-	-	3.8
n	3	0	4	62	0	46	20	1	2	138
3										
Male	490	-	625	496	350	582	491	490	540	537
SE	-	-	-	4.7	-	4.2	15.9	-	-	7.8
n	1	0	1	16	1	25	6	1	1	52
Female	-	390	-	491	-	554	496	-	-	523
SE	-	-	-	6.1	-	5.2	7.4	-	-	5.8
n	0	1	0	16	0	30	9	0	0	56
All	490	390	625	494	350	566	494	490	540	530
SE	-	-	-	3.8	-	3.9	7.4	-	-	4.8
n	0	0	0	32	1	55	15	1	1	108
1-3										
Male	473	-	582	482	350	574	491	490	535	520
SE	7.8	-	12.9	3.5	-	3.5	7.2	-	5.0	4.1
n	4	0	7	82	1	65	16	1	2	178
Female	473	390	533	484	-	540	495	530	530	506
SE	18.6	-	34.4	2.9	-	4.1	3.6	-	0.0	2.9
n	3	1	3	88	0	71	29	1	2	198
All	473	390	568	483	350	556	494	510	533	513
SE	8.2	-	14.6	2.3	-	3.1	3.4	20.0	2.5	2.5
n	7	1	10	170	1	136	46	2	4	376

<sup>1</sup> Period 1 = 7/2-7/23 (sample dates = 7/5-7/20; Period 2 = 7/24-8/13 (sample dates = 7/29-8/12); and, Period 3 = 8/14-9/6 (sample dates = 8/17-8/30.

Appendix Table B-12. Tests for significant differences in the average length of sockeye salmon in the Mountain Lake escapement between three sampling periods.

Brood Year	Age Class	Period One versus Period Two	Period One versus Period Three	Period Two versus Period Three
1984	1.2			
	2.1			
1983	1.3			
	2.2	S*	S**	
	3.1			
1982	2.3		S**	S*
	3.2			
1981	2.4			
	3.3			

S = significant at probabilities = 0.10.  
S\* = significant at probabilities = 0.05.  
S\*\* = significant at probabilities = 0.01.

## APPENDIX C

Appendix Tables C-1 through C-6 provide detailed summaries of the three groups of sockeye salmon tagged at the Situk River weir in 1988 as well as detailed information concerning these fish as they later passed Mountain Lake weir.

Appendix Table C-1. Number of sockeye salmon tagged with orange tags at the Situk River weir in 1988 and associated statistics.

Date	Number of Fish Tagged With Orange Tags	Cumulative Number of Fish Tagged	Daily Proportion of Total	Cumulative Proportion of Total
June 17	2	2	0.0019	0.0019
June 18	0	2	0.0000	0.0019
June 19	1	3	0.0009	0.0028
June 20	0	3	0.0000	0.0028
June 21	0	3	0.0000	0.0028
June 22	21	24	0.0199	0.0228
June 23	0	24	0.0000	0.0228
June 24	2	26	0.0019	0.0247
June 25	4	30	0.0038	0.0285
June 26	35	65	0.0332	0.0617
June 27	24	89	0.0228	0.0845
June 28	311	400	0.2953	0.3799
June 29	653	1,053	0.6201	1.0000
Mean Day of Migration = June 28			Variance = 1.7 days	

Appendix Table C-2. Number of sockeye salmon tagged with yellow tags at the Situk River weir in 1988 and associated statistics.

Date	Number of Fish Tagged With Yellow Tags	Cumulative Number of Fish Tagged	Daily Proportion of Total	Cumulative Proportion of Total
July 8	237	237	0.1443	0.1443
July 9	17	254	0.0104	0.1547
July 10	140	394	0.0853	0.2400
July 11	159	553	0.0968	0.3368
July 12	166	719	0.1011	0.4379
July 13	272	991	0.1657	0.6035
July 14	236	1,227	0.1437	0.7473
July 15	66	1,293	0.0402	0.7875
July 16	161	1,454	0.0981	0.8855
July 17	188	1,642	0.1145	1.0000
Mean Day of Migration = July 13			Variance = 7.9 days	

Appendix Table C-3. Number of sockeye salmon tagged with blue tags at the Situk River weir in 1988 and associated statistics.

Date	Number of Fish Tagged With Blue Tags	Cumulative Number of Fish Tagged	Daily Proportion of Total	Cumulative Proportion of Total
July 26	481	481	0.2600	0.2600
July 27	209	690	0.1130	0.3730
July 28	697	1,387	0.3768	0.7497
July 29	463	1,850	0.2503	1.0000
Mean Day of Migration = July 28			Variance = 1.3 days	

Appendix Table C-4. Daily counts of sockeye salmon with orange tags at Mountain Lake weir in 1988 and associated statistics.

Date	Daily Count	Cumulative Count	Daily Proportion of Total	Cumulative Proportion of Total
July 5	6	6	0.0210	0.0210
July 6	0	6	0.0000	0.0210
July 7	48	54	0.1678	0.1888
July 8	40	94	0.1399	0.3287
July 9	32	126	0.1119	0.4406
July 10	15	141	0.1524	0.4930
July 11	10	151	0.1350	0.5280
July 12	13	164	0.0455	0.5734
July 13	30	194	0.1049	0.6783
July 14	18	212	0.0629	0.7413
July 15	13	225	0.1455	0.7867
July 16	28	253	0.0979	0.8846
July 17	6	259	0.0210	0.9056
July 18	2	261	0.0070	0.9126
July 19	4	265	0.0140	0.9266
July 20	1	266	0.0035	0.9301
July 21	1	267	0.0035	0.9336
July 22	2	269	0.0070	0.9406
July 23	1	270	0.0035	0.9441
July 24	3	273	0.0105	0.9545
July 25	3	276	0.0105	0.9650
July 26	3	279	0.0105	0.9755
July 27	2	281	0.0070	0.9825
July 28	0	281	0.0000	0.9825
July 29	0	281	0.0000	0.9825
July 30	0	281	0.0000	0.9825
July 31	0	281	0.0000	0.9825
August 1	0	281	0.0000	0.9825
August 2	0	281	0.0000	0.9825
August 3	0	281	0.0000	0.9825
August 4	0	281	0.0000	0.9825
August 5	0	281	0.0000	0.9825
August 6	0	281	0.0000	0.9825
August 7	0	281	0.0000	0.9825
August 8	0	281	0.0000	0.9825
August 9	1	282	0.0035	0.9860
August 10	0	282	0.0000	0.9860
August 11	0	282	0.0000	0.9860
August 12	0	282	0.0000	0.9860
August 13	0	282	0.0000	0.9860
August 14	0	282	0.0000	0.9860
August 15	0	282	0.0000	0.9860
August 16	0	282	0.0000	0.9860
August 17	0	282	0.0000	0.9860
August 18	0	282	0.0000	0.9860

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Appendix Table C-4. Continued, page 2 of 2.

Date	Daily Count	Cumulative Count	Daily Proportion of Total	Cumulative Proportion of Total
August 19	0	282	0.0000	0.9860
August 20	0	282	0.0000	0.9860
August 21	1	283	0.0035	0.9895
August 22	1	284	0.0035	0.9930
August 23	0	284	0.0000	0.9930
August 24	1	285	0.0035	0.9965
August 25	1	286	0.0035	1.0000
Mean Date of Migration = July 12				Variance = 48.4 Days

Appendix Table C-5. Daily counts of sockeye salmon with yellow tags at Mountain Lake weir in 1988 and associated statistics.

Date	Daily Count	Cumulative Count	Daily Proportion of Total	Cumulative Proportion of Total
July 13	2	2	0.0073	0.0073
July 14	1	3	0.0036	0.0109
July 15	2	5	0.0073	0.0182
July 16	6	11	0.0218	0.0400
July 17	18	29	0.0655	0.1055
July 18	7	36	0.0255	0.1309
July 19	9	45	0.0327	0.1636
July 20	8	53	0.0291	0.1927
July 21	21	74	0.0764	0.2691
July 22	16	90	0.0582	0.3273
July 23	20	110	0.0727	0.4000
July 24	9	119	0.0327	0.4327
July 25	36	155	0.1309	0.5636
July 26	24	179	0.0873	0.6509
July 27	3	182	0.0109	0.6618
July 28	0	182	0.0000	0.6618
July 29	9	191	0.0327	0.6945
July 30	5	196	0.0182	0.7127
July 31	2	198	0.0073	0.7200
August 1	5	203	0.0182	0.7382
August 2	1	204	0.0036	0.7418
August 3	7	211	0.0255	0.7673
August 4	7	218	0.0255	0.7927
August 5	0	218	0.0000	0.7927
August 6	0	218	0.0000	0.8036
August 7	3	221	0.0109	0.8182
August 8	4	225	0.0145	0.9091
August 9	25	250	0.0909	0.9236
August 10	4	254	0.0145	0.9345
August 11	3	257	0.0109	0.9382
August 12	1	258	0.0036	0.9455
August 13	2	260	0.0073	0.9491
August 14	1	261	0.0036	0.9491
August 15	0	261	0.0000	0.9591
August 16	1	262	0.0036	0.9527
August 17	0	262	0.0000	0.9527
August 18	0	262	0.0000	0.9527
August 19	0	262	0.0000	0.9527
August 20	1	263	0.0036	0.9564
August 21	0	263	0.0000	0.9564
August 22	0	263	0.0000	0.9564
August 23	4	267	0.0145	0.9709
August 24	2	269	0.0073	0.9782
August 25	1	270	0.0036	0.9818
August 26	1	271	0.0036	0.9855
August 27	0	271	0.0000	0.9855

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Appendix Table C-5. Continued, page 2 of 2.

Date	Daily Count	Cumulative Count	Daily Proportion of Total	Cumulative Proportion of Total
August 28	2	273	0.0073	0.9927
August 29	0	273	0.0000	0.9927
August 30	0	273	0.0000	0.9927
August 31	1	274	0.0036	0.9964
September 1	1	275	0.0036	1.000
Mean Date of Migration = July 28				Variance = 98.3 Days

Appendix Table C-6. Daily counts of sockeye salmon with blue tags at Mountain Lake weir in 1988 and associated statistics.

Date	Daily Count	Cumulative Count	Daily Proportion of Total	Cumulative Proportion of Total
August 3	3	3	0.0106	0.0106
August 4	1	4	0.0035	0.0141
August 5	0	4	0.0000	0.0141
August 6	0	4	0.0000	0.0141
August 7	5	9	0.0177	0.0318
August 8	11	20	0.0389	0.0707
August 9	51	71	0.1802	0.2509
August 10	8	79	0.0283	0.2792
August 11	8	87	0.0283	0.3074
August 12	9	96	0.0318	0.3392
August 13	12	108	0.0424	0.3816
August 14	6	114	0.0212	0.4028
August 15	5	119	0.0177	0.4205
August 16	3	122	0.0106	0.4311
August 17	6	128	0.0212	0.4523
August 18	6	134	0.0212	0.4735
August 19	2	136	0.0071	0.4806
August 20	6	142	0.0212	0.5018
August 21	11	153	0.0389	0.5406
August 22	23	176	0.0813	0.6219
August 23	26	202	0.0919	0.7138
August 24	19	221	0.0671	0.7809
August 25	6	227	0.0212	0.8021
August 26	6	233	0.0212	0.8233
August 27	0	233	0.0000	0.8233
August 28	6	239	0.0212	0.8445
August 29	4	243	0.0141	0.8587
August 30	8	251	0.0283	0.8869
August 31	8	259	0.0283	0.9152
September 1	5	264	0.0177	0.9329
September 2	14	278	0.0495	0.9823
September 3	4	282	0.0141	0.9965
September 4	1	283	0.0035	1.0000
Mean Date of Migration = August 19			Variance = 70.1 Days	

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